# REPORT

## on

# MANTENO STATE HOSPITAL TYPHOID FEVER EPIDEMIC 1939

Published by
The Illinois Department of Public Health

THOMAS J. PARRAN

## ERRATA

The attention of the reader is requested to the following omissions and printing errors:

Page 21: In Table III, 5th column, the top figure "80" should be "50."

Page 25: In the last paragraph, the first sentence should have added to its end the phrase "in relatively great numbers."

Page 55: In the last paragraph, sixth line, the word "contrasted" is misspelled.

Page 60: In the fourth paragraph, fourth line, appears the word "died" which should be changed to "diet."

# A REPORT ON A TYPHOID FEVER EPIDEMIC AT MANTENO STATE HOSPITAL IN 1939



Prepared largely from
the unpublished reports and findings of
CARL E. SCHWOB and C. MILTON EBERHART, M.D.,
*by*
Members of the Staff,
State Department of Public Health,
ROLAND R. CROSS, M.D., *Director*



Published by Authority of the State of Illinois
DWIGHT H. GREEN, *Governor*
1945

(84775—5M—6-45)

# INTRODUCTION

THE following report is concerned with various public-health aspects of an epidemic of typhoid fever which occurred in a State hospital for the mentally ill at Manteno, Illinois, in 1939, involving 453 cases and resulting in 60 deaths. Although the epidemic began early in August, and continued into October, the material incorporated in the report was gathered, for the most part, subsequent to August 21, and the report covers a period of several months after the subsidence of the epidemic.

The activities described in this report were directed along two major lines: (1) determination of the means of transmission of the disease at the hospital, and (2) institution of control measures to prevent further transmission of the disease there.

No effort is made in the report to present a full account of the history and technicalities of the legal actions and court procedures to which the epidemic led. A brief resumé is given, however, of those factual points in the legal actions that would appear to be of special interest from a public health standpoint.

Although the public-health findings as presented to the Supreme Court of Illinois in the course of the legal actions were held by the Court to have little probative value, it is hoped that this report may serve a useful purpose in recording the development and management of an epidemic of typhoid fever in a hospital for the mentally ill.

## CHAPTER I

# DESCRIPTION OF MANTENO STATE HOSPITAL

A description of the institution, including location and geology of the area, is necessary to provide a proper background for a thorough understanding of the epidemic and the many unusual problems involved in its control.

GENERAL. The Manteno State Hospital is an institution for mentally ill persons. It is located in Kankakee County, approximately 40 miles south of Chicago and 10 miles north and east of the City of Kankakee. Situated 2 miles from the nearest municipality (Manteno) on a tract of ground comprising approximately 1,000 acres, its 100 buildings virtually comprise a small municipality. At the time of the epidemic the institution generated its own power, furnished its own water supply, and maintained a system of sewers and sewage-treatment works. Fig. 1 is a map showing general layout of the institution.

HISTORICAL. Construction on the Manteno State Hospital started in the year 1929, additional buildings, utilities, and other facilities being provided in the ensuing years up to the time of the outbreak. Building construction was in progress at the time the epidemic occurred. The accompanying Table I shows the growth of population for the institution. It will be noted that the population at the time of the epidemic was approximately 6,200.

ADMINISTRATION AND OPERATION. Prior to the 1939 typhoid fever outbreak, the administration and operation of the institution were characteristic of procedures followed in other State institutions of this kind. The institution was under the direct supervision of a managing officer, who was directly responsible to the director of the Department of Public Welfare.

The medical department was under the supervision of a clinical director, who supervised the activities of 20 staff physicians and the laboratory technicians. The nursing department was directed by a trained nurse, who was assisted by a number of supervisors all of whom were untrained lay persons. The registered nurses in the administrative plan took their orders from the lay supervisors, who, in turn, were responsible for contacting the staff physicians. The attendants in this department consisted of lay persons who also were responsible for nursing care.

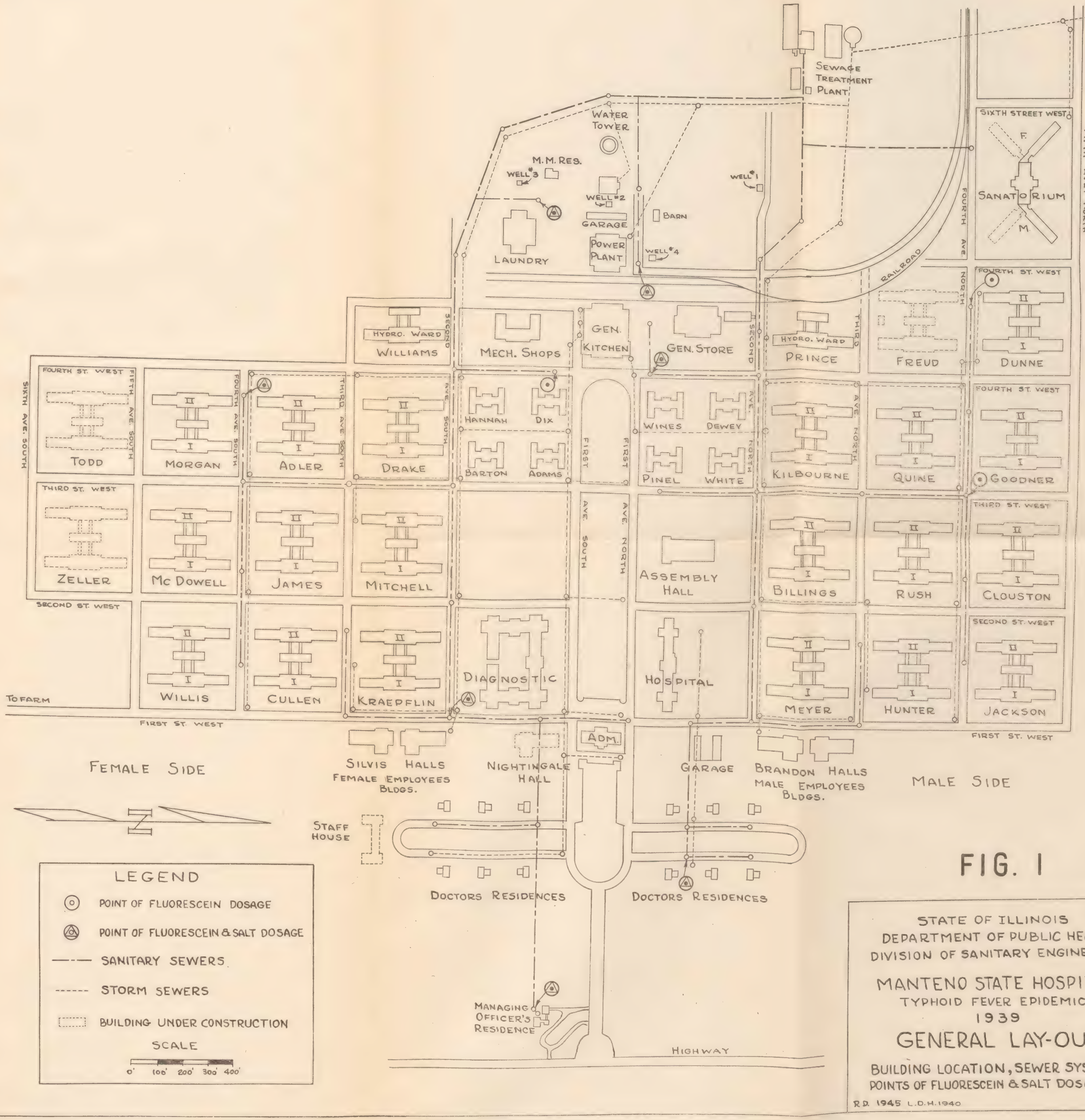
The dietary department was under the supervision of a dietitian. Approximately 85% of the workers in the dietary department were patients, the remainder, only, being paid employees. The institution maintained it own farms, operated primarily for the growing of vegetables. Most of the meat was purchased from packing houses, but a hog farm furnished a portion of the meat supply. An institution dairy herd furnished about 100 gallons of raw milk daily, which was used only for cooking purposes, the main milk supply coming from an outside pasteurization plant.

# TABLE I

## MANTENO STATE HOSPITAL

### Population by Years 1931 to 1940

| DATE | PATIENTS | | | EMPLOYEES | | | Grand Total | Employee-to-Patient Ratio |
|---|---|---|---|---|---|---|---|---|
| | Male | Female | Total | Male | Female | Total | | |
| 1931 (Jan 1) | 100 | 0 | 100 | 63 | 10 | 73 | 173 | 1.37 |
| 1932 " | 410 | 414 | 824 | 108 | 74 | 182 | 1,006 | 4.5 |
| 1933 " | 494 | 458 | 952 | 105 | 73 | 178 | 1,130 | 5.34 |
| 1934 " | 512 | 669 | 1,181 | 87 | 91 | 178 | 1,359 | 6.64 |
| 1935 " | 524 | 680 | 1,204 | 99 | 93 | 192 | 1,396 | 6.28 |
| 1936 " | 1,459 | 1,201 | 2,660 | 207 | 184 | 391 | 3,051 | 6.8 |
| 1937 " | 1,619 | 1,202 | 2,821 | 207 | 180 | 387 | 3,208 | 7.3 |
| 1938 " | 1,915 | 1,640 | 3,555 | 270 | 252 | 522 | 4,077 | 6.8 |
| 1939 " | 2,687 | 2,638 | 5,325 | 350 | 380 | 730 | 6,055 | 7.3 |
| 1939 (July 1) | 2,711 | 2,673 | 5,384 | 370 | 398 | 768 | 6,152 | 7.0 |
| *1939* | | | | | | | | |
| Aug. | 2,705 | 2,696 | 5,401 | 370 | 398 | 768 | 6,169 | 7.1 |
| Sept. | 2,713 | 2,688 | 5,401 | 426 | 455 | 881 | 6,282 | 6.1 |
| Oct. | 2,660 | 2,662 | 5,322 | 469 | 471 | 940 | 6,262 | 5.6 |
| Nov. | 2,613 | 2,626 | 5,239 | 488 | 481 | 969 | 6,208 | 5.4 |
| Dec. | 2,580 | 2,573 | 5,153 | 490 | 481 | 971 | 6,124 | 5.3 |
| *1940* | | | | | | | | |
| Jan. | 2,518 | 2,507 | 5,025 | 493 | 483 | 976 | 6,001 | 5.2 |
| Feb. | 2,566 | 2,513 | 5,079 | 495 | 486 | 981 | 6,060 | 5.2 |
| Mar. | 2,616 | 2,554 | 5,170 | 445 | 473 | 918 | 6,088 | 5.6 |




# FIG. 1

STATE OF ILLINOIS
DEPARTMENT OF PUBLIC HEALTH
DIVISION OF SANITARY ENGINEERING

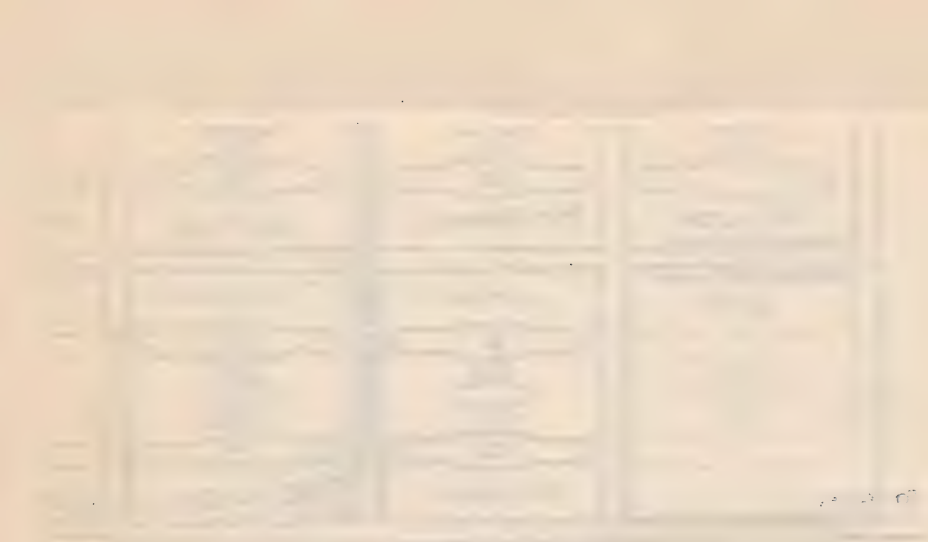
## MANTENO STATE HOSPITAL

TYPHOID FEVER EPIDEMIC
1939

## GENERAL LAY-OUT

BUILDING LOCATION, SEWER SYSTEMS & POINTS OF FLUORESCEIN & SALT DOSAGE

R.D. 1945 L.D.H. 1940



The institution maintained its own bakery. All meals were prepared in the central kitchen, except for a few hospital cases requiring special diets. At the time of the epidemic approximately 19,815 meals were being served daily. Food prepared in the central kitchen was transported in aluminum food-containers by trucks to the various ward kitchens, from which it was usually served in cafeteria style.

The mechanical department was under the supervision of a master mechanic whose responsibilities included the operation of the water supply, sewerage, garbage- and rubbish-disposal, and insect- and rodent-control, in addition to the maintenance of the power plant, and care of the grounds.

Table II shows the number and classification of hospital employees from the year 1937 to 1940. It will be noticed that the number of employees in the mechanical department decreased from 19 in June, 1937, to 14 in June, 1939, while Table I shows that the population of the institution increased during that period from 3,208 to 6,152.

GEOLOGY. The subsurface formations at the institution are extremely important in the study of this epidemic. The area in which the institution is located is underlain near the surface with limestone which is cracked, creviced, and filled with solution channels. Such formation is universally credited by geologists with the character of conveying water and likewise pollution for great distances without effecting purification. The glacial drift covering the creviced limestone in the area is relatively thin, on the institution grounds varying from 0 to about 30 feet in thickness. In the southern portion of the institution grounds the rock outcrops, while at a distance of several hundred feet north the drift is 20 feet thick. Fig. 2 gives the depth and thickness of underground formations at the site of one of the institution wells. During construction of the institution, some of the building foundations had to be excavated in rock; likewise, it was necessary to lay some of the sewers in trenches excavated in the rock formation. Extensive studies by State geologists were made both before and after the epidemic occurred so that the general shallowness of the glacial drift and the creviced character of the underlying limestone have been very definitely established.

WATER SUPPLY. The institution water supply was obtained from 4 drilled wells, all located within a few hundred feet of each other on the institution grounds. The wells all discharged to a concrete ground-storage reservoir, from which the water was pumped to the institution distribution system on which pressure was maintained by an elevated tank. Three of the wells obtained their water solely from the creviced limestone, the wells being cased from the surface to only a short distance into the rock formation. The other well penetrated deeper rock formations, but that portion of the well passing through the creviced limestone was not cased out so that this well, likewise, received a portion of its water from the creviced limestone formation. Fig. 2 gives the logs and casing records of all the wells. For a month prior to the epidemic all water furnished the institution was obtained from one well only—that known as "No. 4"—which was drilled in 1938 and was located approximately 50 feet north of the power plant. This well had a total depth of 225 feet and was cased with 14-inch casing from the surface to a depth of only 19 feet, the casing

## TABLE II

## MANTENO STATE HOSPITAL

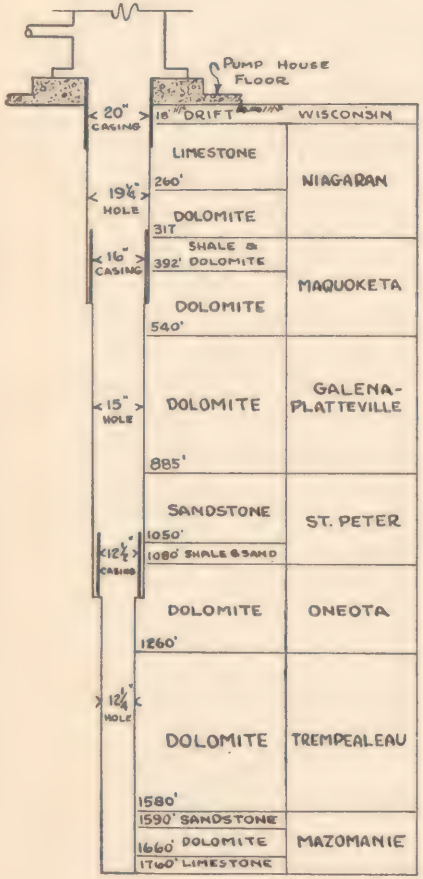
### Number and Classification of Hospital Employees During Period 1937 to 1940.

| Date | Physicians | Registered Nurses | Attendants | Mechanical Department | Dietary | Sanitary |
|---|---|---|---|---|---|---|
| *1937* | | | | | | |
| June..... | 9 | 3 | 358 | 19 | 6 | |
| *1938* | | | | | | |
| June..... | 17 | 10 | 541 | 13 | 6 | |
| *1939* | | | | | | |
| Jan..... | 24 | 12 | 607 | 13 | 8 | |
| Feb..... | 23 | 14 | 621 | 13 | 9 | |
| Mar..... | 24 | 22 | 606 | 14 | 9 | |
| Apr..... | 24 | 22 | 611 | 14 | 9 | |
| May..... | 25 | 22 | 613 | 14 | 9 | |
| June..... | 23 | 22 | 619 | 14 | 10 | |
| July..... | 23 | 21 | 621 | 15 | 10 | |
| Aug..... | 23 | 22 | 620 | 16 | 9 | |
| Sept..... | 23 | 109 | 719 | 16 | 15 | |
| Oct..... | 23 | 108 | 751 | 16 | 15 | |
| Nov..... | 22 | 86 | 709 | 18 | 14 | |
| Dec..... | 22 | 64 | 701 | 18 | 15 | |
| *1940* | | | | | | |
| Jan..... | 26 | 47 | 732 | 19 | 17 | |
| Feb..... | 26 | 46 | 720 | 18 | 18 | 8 |

penetrating into the limestone for a depth of only 1 foot. Thus, the glacial drift at this well was only 18 feet thick and all water which this well supplied was developed from the creviced limestone. The static water level was reported at the time of the epidemic at 26 feet below the ground surface. A sanitary sewer line serving the power house passed only 35 feet south of the well casing. This sewer was constructed of vitrified sewer pipe, with ordinary cement mortar joints. Fig. 3 is a detailed layout of the water supply, and shows the location of sewers with respect to the wells. The water consumption at the institution was approximately 1,000,000 gallons per day. Although water distributed to the hot-water system was softened by the zeolite process and boiler water was conditioned by a hot-lime process, the remainder of all water furnished the institution was distributed without treatment of any kind previous to the epidemic.

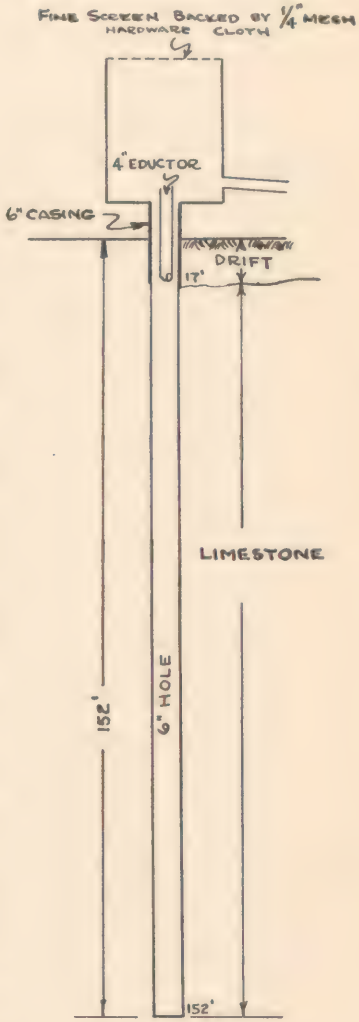
SEWERAGE. The institution was served by a system of separate sewers, one for sanitary wastes and the other for storm water. As pre-

YIELD - 430 G.P.M.
DISCHARGE TO COLLECTING RESERVOIR



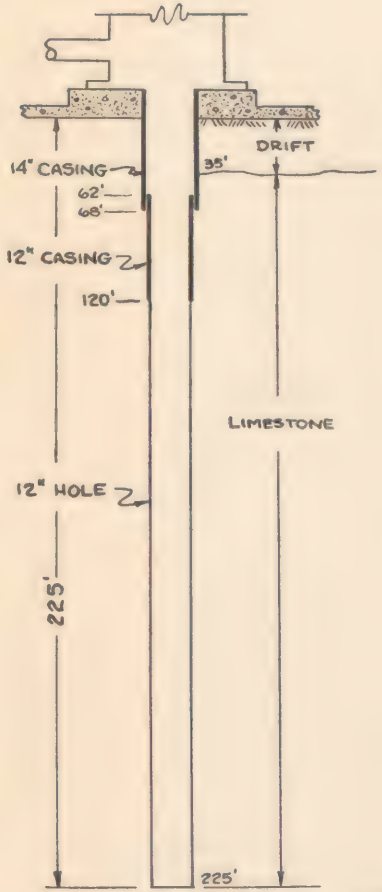

WELL NO. 1
DRILLED 1930 - 1760' DEEP
LOCATED 500 FT N.W. OF POWER HOUSE

YIELD - 75 G.P.M.
PUMPED BY AIRLIFT
DISCHARGES TO COLLECTING RESERVOIR



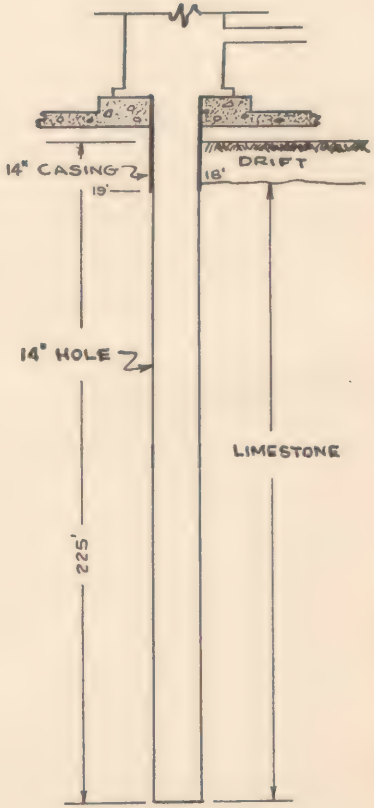

WELL NO. 2
152' DEEP
LOCATED IMMEDIATELY WEST OF BLACKSMITH SHOP

YIELD - 285 G.P.M.
DISCHARGES TO COLLECTING RESERVOIR




WELL NO. 3
DRILLED 1934 225' DEEP
LOCATED 400 FEET SO. OF WELL #2 AND WEST OF LAUNDRY BLDG.

YIELD - 460 G.P.M.
DISCHARGES TO COLLECTING RESERVOIR




WELL NO. 4
DRILLED 1938 225' DEEP
LOCATED APPROX. 50 FEET NORTH OF POWER HOUSE

# FIG. 2

STATE DEPT. OF PUBLIC HEALTH
DIVISION OF SANITARY ENGINEERING

## WELL DETAILS

MANTENO STATE HOSPITAL
INSPECTION NOV 12-15, 1940

L.D.H. 12-40-9-39 2.D.45

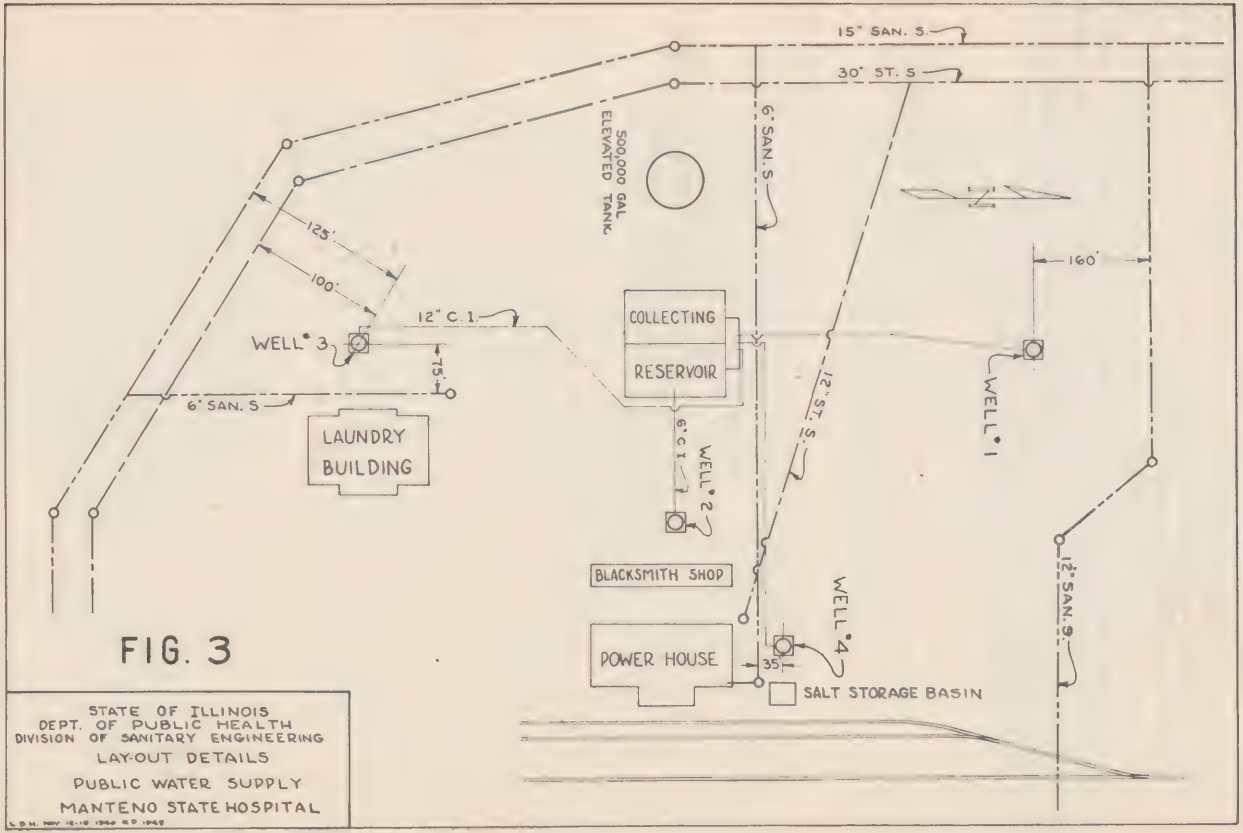



FIG. 3

STATE OF ILLINOIS
DEPT. OF PUBLIC HEALTH
DIVISION OF SANITARY ENGINEERING
LAY-OUT DETAILS
PUBLIC WATER SUPPLY
MANTENO STATE HOSPITAL

I.D.H. NOV 18-10 1960 C.D. 1948

viously indicated, some of these sewers were laid in creviced limestone because of the thin glacial-drift covering at certain points on the institution grounds. Sewage from the sanitary sewer system was treated in the institution sewage-treatment plant, of the activated sludge type, which was built in 1930 and was designed to give complete treatment to the wastes for a population of 3,000; however, at the time of the epidemic, the sanitary wastes from approximately 6,200 persons were being discharged to the plant, which so heavily overloaded it that it was not possible to produce a satisfactorily treated effluent. The outlet from the sewage-treatment works discharged to a small creek, which flowed through land used for agricultural and dairy purposes. Fig. 1 shows the system of sanitary and storm sewers, and gives the location of the sewage-treatment plant.

## CHAPTER II

# ONSET OF EPIDEMIC

The official records of the State Department of Public Health show that no cases of typhoid fever had been reported from the time the institution was opened in 1931, through 1935. However, during the Fall of 1936, four inmates of the institution became ill with this disease. There was one additional case reported in February, 1937. No cases of typhoid fever were reported in 1938. Of the four cases occurring in 1936, the onsets were approximately one month apart, and there was nothing to indicate that the water supply was involved. The spacing of the cases apparently pointed to infection by direct contact with another case or a carrier. No carriers were reported found in the institution following the occurrence of these cases.

On July 8, 1939, the first person to become ill with typhoid fever at Manteno State Hospital was a male inmate, "J. O.," who was 30 years of age. This patient was admitted to Manteno State Hospital from Elgin State Hospital on August 15, 1935. At that time he was placed in one of the wards, named Quine Cottage, where he remained until the onset of his illness. According to staff physicians, this man had not registered any complaints, but on the 8th of July he became delirious and was transferred to the hospital proper. The outstanding signs were the abnormal temperature (which varied between 101 and 104 degrees), a relatively slow pulse rate, and rapid loss of weight. The differential diagnosis included tuberculosis of the abdomen, and pneumonia. These diseases were ruled out on the 10th of July when an X-ray examination was made.

A maculo-papular eruption was noted and blood specimens were submitted for typhoid culture and Widal test. A report from the Division of Laboratories dated July 17 indicated that the agglutination test was positive in a dilution of 1:640 with H antigen but negative with O antigen. The blood-culture specimen was received July 17, and a report dated July 24 indicated there had been no growth of any bacteria. The patient died on July 15.

This man was first placed in a mental institution in 1928, when he was classified as a mentally deteriorated male patient. After being placed in Quine Cottage he was not allowed away from this ward; and, consequently, lived, ate, and slept in this one building with the exception of those times when the patients were taken out for short walks under the supervision of an attendant. With the exception of food that was brought in from outside by the patient's family, all foods which he consumed were prepared in the central kitchen of the institution and were served in the ward with the assistance of some of the inmates.

The first case was reported to the Illinois Department of Public Health on July 19, and was investigated by one of the district health superintendents on July 21.

During the investigation it was recommended to the managing officer of the institution that all persons who had been in contact with the case should receive typhoid vaccination and also should submit 2 specimens of feces and urine, at least 24 hours apart, to be examined for typhoid bacilli, as the quarantine regulations of the Illinois Department of Public Health required at that time.

Typhoid-release containers for feces and urine were sent to the institution by the Department of Public Health on July 24. In a letter dated August 2, the managing officer of the institution gave a list of the contacts of this typhoid case and stated that they were receiving typhoid vaccine. At that time he also acknowledged that the typhoid-release containers had been received; however, the Department of Public Health laboratory did not receive feces and urine specimens from the contacts until August 10. The reports on these specimens from the laboratory were all negative and were dated August 14.

Later examination of the staff-meeting notes at Manteno State Hospital disclosed that on July 15 "E. S.," a female patient in Adams Cottage, had been sent to the hospital with chills, fever, vomiting, and diarrhea. On July 16, a male inmate from Billings Cottage had been sent to the hospital with similar complaints. On July 21, diarrhea was reported among the inmates in Billings Cottage. Other patients were also reported who had symptoms suspiciously like those of typhoid, but on whom no definite diagnosis had been made. It should be noted in this connection that widespread outbreaks of diarrhea were not uncommon in this institution; and, consequently, not much importance was attached by the staff physicians to the cases of diarrhea occurring in the latter part of July.

Reference to the graph showing the various dates of onset for patients reported as having typhoid fever indicates that apparently the epidemic reached a peak on August 15 in the case of employees and other persons working on the institution grounds, whereas the peak for inmates on this chart apparently is August 23. (See Figs. 5 and 6, Chapter VII.) It should be pointed out that sane persons are more apt to complain and apply for aid sooner than persons who are mentally ill. In a disease such as typhoid fever, in which the onset is insidious, this fact may prove to be a complication in compiling epidemiological data. This is also borne out by examination of the staff-meeting records for Manteno State Hospital.

From this record it was noted that one of the staff physicians reported on August 20 that he received calls, as officer of the day, from many wards about patients' being ill and having temperatures of 104 and 105 degrees.

These patients were reported to the physican at the time as all new cases, but he found later that they had all been ill for several days previous to the time their condition had been reported to him. Further examination of this record shows that the dates of onset for inmates, as reported to the Department of Public Health by the institution authorities or gathered from patients' hospital records, were inaccurate. For instance, one female patient, "H. M.," had been reported to the Department of Public Health as having first become ill on August 26, while the staff-meeting record for August 22 showed that a physician had seen this patient on that date and at that time she had a temperature of 102 and had been sick for 5 days pre-

viously. Likewise, a male patient, "G. McC," had been reported on the patients' hospital record as becoming ill on August 19. However, the staff-meeting record for August 10 showed that the ward physician examined this patient on that date and found him to have a temperature of 101, with cough, chills, and rales in the chest, which were common typhoid prodromal symptoms in this epidemic.

Early during the month of August, cases of diarrhea with temperature were reported from various male and female wards on the hospital grounds. Other cases having abnormal temperature only and such generalized symptoms as headache and backache were reported, but apparently no definite diagnosis had been made of any of these and they were treated, for the most part, while remaining on their respective wards and cottages. It is possible that many of these individuals were suffering from typhoid fever in a mild form, and, therefore, as possibly missed cases may have constituted a source of infection and hazard to other persons on those wards, since no precaution was taken in the disposal of feces and urine from these ill inmates and their contaminated dishes and linens received no special care.

The possibility of existence of a typhoid epidemic was apparently not recognized by the staff physicians until about August 15, at which time a telegraphic request was made to the Department of Public Health for containers in which to submit blood specimens for aggultination tests and typhoid cultures. Specimens from 4 patients were received in the Division of Laboratories on August 17. Agglutination tests on these were negative but *E. typhosa* was isolated from 3 of the specimens. A telephone report was made on August 19 to the assistant managing officer at Manteno State Hospital indicating that the results of these blood cultures would probably be positive. During this telephone conversation the assistant managing officer informed the chief of the Division of Laboratories that there were more than 100 cases of suspected typhoid on the institution grounds. It was agreed during this telephone conversation that a Department of Public Health laboratory-staff member should go to the institution. The remainder of August 19 and Sunday, August 20, were spent in preparing media and supplies for an extensive laboratory study of the outbreak.

When it became apparent that an epidemic was occurring, the director of the Department of Public Health on his own initiative ordered public-health personnel to proceed to the institution. Illinois law charges the Department of Public Health with the duty to " . . . investigate the causes of dangerously contagious or infectious diseases, especially when existing in epidemic form, and take means to restrict and suppress the same . . ." and when ". . . local authorities neglect or refuse to enforce efficient measures for its restriction or suppression or to act with sufficient promptness or efficiency the Department of Public Health may enforce such measures as it deems necessary to protect the public health . . . " Further, the State Civil Administrative Code provides, "The Department of Public Health shall have power: . . . .To make sanitary, sewage, health and other inspections and examinations for the charitable, penal and reformatory institutions . . ." In other words, the Department of Public Health can make inspections of State institutions and submit recommendations for needed improvements, but has no authority to act as a control agency until an epidemic actually occurs. As will be disclosed in Chapter IV, in which the institution water supply is discussed in detail,

the Department of Public Health had made inspections of the institution sanitary facilities and had repeatedly made recommendations to the institution authorities for correction of defects in the water-supply system.

Accordingly, on August 19, the director of the Department of Public Health called the director of the Department of Public Welfare by telephone and advised that Department of Public Health personnel were being sent to the institution to assist in controlling the epidemic. The director of the Department of Public Welfare then, on that date, authorized the installation of an emergency chlorinator on the institution water supply. A chlorinator company in Chicago was called by the institution officials, and by the late afternoon of August 19 an emergency chlorinator was installed.

A Department of Public Health sanitary engineer arrived at the institution on August 21 and proceeded with preliminary surveys on sanitary conditions at the institution. A Department of Public Health physician and a bacteriologist also arrived at the institution on August 21, and from that date through the remainder of the epidemic representatives of the Department of Public Health were present at the institution at all times.

It soon became evident that a thorough and complete investigation of the cause of the epidemic, and the development and execution of measures to control it, would require the services of many persons experienced in public-health work. Additional epidemiologists were sent to the institution to collect epidemiological data and to render consultation services in clinical diagnosis of typhoid fever cases. An emergency laboratory was established at the institution, operated by experienced bacteriologists. Several more sanitary engineers were detailed to the institution to conduct surveys on pollution and plumbing, and to examine food-handling methods. Milk sanitarians were required to check the milk supply.

There was an insufficient number of registered nurses at the institution to carry out isolation technique properly, and considerable difficulty was experienced in getting the lay attendants to execute the strict isolation measures necessary. Therefore, on September 20 nine Public Health Department nurses were sent into the institution to serve on the various isolation wards and supervise isolation technique in those places.

Some administrative difficulty was encountered in obtaining immediate execution of control measures by regular institution personnel. Consequently, by agreement between the director of the Department of Public Health and the director of the Department of Public Welfare, on September 19 an experienced Department of Public Health sanitary engineer was loaned to the Department of Public Welfare in order that he might serve as assistant managing officer of the institution and in this capacity be in direct charge of the control of the epidemic. This transfer greatly facilitated the prompt execution of necessary control measures, because it established a direct liaison between the personnel of the two State departments and resulted in a marked improvement in the co-operation of the institution employees.

Many of the Department of Public Health personnel were retained at the institution for several months. The estimated cost of the epidemic to the State of Illinois for both the Department of Public Health and the

Department of Public Welfare for extra personnel, travel and maintenance expense, and supplies, occasioned by the outbreak, was $120,000. This does not include any cost for time and loss of life by those who contracted the disease.

## CHAPTER III

## PRELIMINARY OBSERVATIONS

Upon arrival of the Department of Public Health personnel at the institution, a survey was made of the existing control measures in order to determine their efficiency and to institute whatever additional measures were necessary to control the epidemic.

WATER SUPPLY. It was found that all of the water for the institution was being obtained from Well No. 4, which had its source of supply in the shallow Niagaran limestone. This well was cased only through 18 feet of drift and 1 foot into the limestone. An emergency chlorinator had just been installed. Chlorine was being fed into the pump-suction line at a point approximately 15 feet from the high-service pump. Due to the fact that the high-service pumps discharged directly into the distribution system, the retention period provided between the point of application of chlorine and points where the water was consumed was not adequate to provide proper disinfection. Analyses of samples of this water showed that contamination still persisted after chlorination.

TYPHOID WARD WASTE DISPOSAL. A survey of the method of handling the wastes from the typhoid patients showed that it was not satisfactory, because the wastes were in some instances being placed directly into the sewer, and, other instances the material was collected in cans and hauled to a field for burial.

No attempt had been made to close off the sewers in the isolation buildings to keep contaminated material from going to the sewer and sewage-treatment works.

TYPHOID WARD LINEN. The handling of linens from the typhoid wards was found to be unsatisfactory. Large piles of soiled linens were found lying on the porches of the typhoid wards, where they were exposed directly to flies. Soiled sheets were lying on the floor in the typhoid wards proper and in the bathrooms.

SEWERAGE. The plumber was contacted to determine if any serious sewer stoppage had occurred. He advised that a sewer stoppage on First Avenue in front of Silvis Hall had been remedied a few days before. Upon examination and checking with dye, it was found that sewage from the sanitary sewer was finding its way to the storm sewer, which sewer was approximately 12 feet from the sanitary sewer. It was found, also, that there was a stoppage of the sanitary sewer located in the street between the power house and Well No. 4, and that sewage was standing to a depth of several feet in the manhole located approximately 80 feet from Well No. 4. Details on these sewer stoppages will be found in Chapter IV.

DIETARY DEPARTMENT. A hurried check revealed that there was a serious fly situation in the central kitchen and the dining rooms and that the kitchen was extremely dirty. Patients who

were working in the kitchen were dirty. It was noted that brooms used for scrubbing floors were later used for cleaning the cooking utensils and the meat block where meat was carved. An objectionable odor nuisance also existed both inside and outside the kitchen.

A dishwashing machine in use in the central kitchen provided only a 12-second interval from the time the dishes entered until they were discharged. The same method of dishwashing was used in the majority of the ward kitchens. In ward kitchens, where no dishwashing machines were provided, dishes were washed by hand. No attempt was made to sterilize the dishes after washing by either method. Dish towels were used throughout the institution by patients in drying the dishes; also, a great deal of difficulty was encountered in securing a sufficient number of towels. Cans used for transporting food from the central kitchen to the ward kitchens were returned, in many instances, to the central kitchen without having been cleaned.

Food-handlers, both patients and employees, had not been checked to determine whether or not they were carriers of infectious disease.

Several discarded bathtubs were being used in the basement of the central kitchen as receptacles for vegetables which were being prepared. The enamel was badly chipped on these tubs and they were otherwise in a poor sanitary condition. The situation prevailing in this room was not satisfactory because of overcrowding of inmate workers and the necessity of preparing, at times, 100 bushels of potatoes for a meal together with the other vegetables which were required. The drainage facilities in the peeling room were also inadequate; and, as a result, the floor was flooded at times.

In bringing the vegetables from the peeling room to the central kitchen, they were transported around the building, a distance of approximately 500 feet, by a small hand truck. In the process of transportation these vegetables were subjected to flies, dust, dirt, and other contaminating substances.

The milk supply coming to the institution was from an approved milk-pasteurization plant; however, there were approximately 100 gallons of raw milk produced on the institution farms each day. This raw milk was used only for cooking and in a boiled ice-cream mix.

Dishes used by hospitalized patients and employees, which included typhoid patients and typhoid suspects besides the ordinary population, were being returned to the hospital kitchen from the bedsides without proper disinfection.

It was found that relatives and friends visiting employees in the hospital who were ill with typhoid fever were going from the typhoid patients' bedsides into the hospital kitchen and were handling dishes, food, etc.

GARBAGE. Garbage at the institution was being collected by a horse-drawn wagon, and the garbage box provided was not watertight. As a result, whenever the garbage wagon stopped for collection, pools of garbage were formed, thereby creating fly-breeding and odor nuisance over the entire grounds. Garbage cans from the individual ward kitchens were set along the roadway and in most instances the areas around the garbage cans were covered with garbage that had been spilled. Also, there was a lack of lids for these garbage cans and no attempt was made to wash the cans after the garbage had been collected.

At the central kitchen, garbage was placed in galvanized iron cans on the rear platform of the kitchen, and if cans were not available the garbage was dumped directly onto the ground. Here again, a serious fly and odor nuisance existed.

RUBBISH. Rubbish from the institution was collected with a horse-drawn vehicle and taken to the north farm where it was deposited near the garbage dump. On windy days the paper and other material were blown over the landscape and presented a very untidy, ill-kept appearance. Tin cans from the kitchen were not charred and crushed, and, again, an excellent feeding place for flies was created. Attempts were made to burn all combustible material in the rubbish; however, this was not possible on windy days.

RODENT CONTROL. Very little attention was paid to rodent control at the institution and as a result many mice and rats were present. An ample food supply for rodents was available around garbage cans and at the garbage dump.

There was a very bad infestation of rats at the sewage-treatment plant, where screenings from the barscreen were dumped and not properly covered.

FLY AND INSECT CONTROL. At the start of the epidemic the institution was infested with flies and cockroaches. There was profuse fly breeding at the sewage-screenings dump, garbage cans throughout the institution, manure piles, and at places where fecal matter had been deposited by patients (particularly behind bushes around the buildings and in the grove behind the power house). Probably the worst condition existed at the sewage-screenings dump where it was noted that the entire dump was literally alive with maggots. Cockroaches were so prevalent that they were noted in the sleeping rooms and even in the beds of some of the various wards.

The central kitchen was infested with flies, due partly to the remodeling activities which made it impossible to have all openings properly screened and partly to the fact that traffic was through one outside door.

The hospital, including the operating and post-mortem rooms, was overrun with flies due to improperly fitted screens.

## CHAPTER IV

## WATER-SUPPLY STUDY

It was noticed early in the investigation that there was no definite localization of typhoid fever cases to any one ward or group of wards, a fact which indicated that the source of infection must have been associated with a factor common to all wards of the institution. This directed suspicion toward water, food, milk, and ice cream. Since the water supply had always been of questionable sanitary quality, it was deemed advisable to make a detailed study of this possible means of transmission.

PREVIOUS RECORD OF POLLUTION OF WATER SUPPLY. As indicated in Chapter I, the institution water supply was secured from wells obtaining water from creviced limestone. This limestone, known as the Niagaran, is badly cracked and creviced and contains solution channels that may carry pollution for great distances. The shallowness and complete absence in places of the glacial-drift covering at the site of the institution further increased the hazard to such a water-supply source.

Plans and specifications for the institution water supply were not submitted to the Department of Public Health for review before the installation was made; and, consequently, Department of Public Health approval was never issued. When the water supply was first placed in operation, early in 1931, a Department of Public Health sanitary engineer made an inspection, and samples of water were submitted for analysis on the same day. Results of water analyses showed the presence of contamination, and the institution officials were immediately informed by telegram of the results, with the recommendation that all drinking water be boiled and that chlorination of the water supply be instituted. This first inspection disclosed that the water was being obtained from the creviced limestone. An opinion was then requested by the Department of Public Health from the Illinois State Geological Survey, which organization made a study and reported in part as follows: "Not only will the proximity of the limestone to the present surface be dangerous for obtaining water from the Niagaran, but the fact that sewers and other constructions extended into the rock makes it imperative that the water from this well be constantly watched and perhaps treated with chlorine continually." The managing officer of the institution was immediately informed of the State Geological Survey opinion, and the hazard of utilizing water obtained from the creviced limestone was stressed. A formal report was then prepared and submitted to the director of the Department of Public Welfare.

In this first official report of the Department of Public Health on the Manteno State Hospital water supply, dated March 31, 1931, the director of the Department of Public Welfare was informed that by inspection and results of analyses the supply was found to be contaminated, there was possibility of the entrance of dangerous contamination because of the underlying creviced limestone formation, and that continuous and adequate chlorination should be adopted or the wells reconstructed in order to case out undesirable

water from the limestone formations. This report was submitted only a short time after the new institution was formally opened for occupancy.

Again, in a formal report dated November 22, 1935, to the director of the Department of Public Welfare on the institution water supply, the State Department of Public Health repeated its former warnings pertaining to the hazard from the shallow creviced limestone and its recommendation that chlorination be adopted. Under date of September 21, 1937, a third formal water-supply report on the institution was submitted to the director of the Department of Public Welfare, again warning of the hazard because of the creviced limestone and recommending that a chlorinator be installed. The following paragraph was included in this report:

> "These defects in the Manteno State Hospital water supply have existed for a number of years and we have previously called the attention of the hospital officials to these dangers. The Manteno State Hospital officials are not exercising the 'reasonable care' necessary in the maintenance of an institutional water supply and should an epidemic of water-borne illness occur the officials would be responsible for negligence in not protecting the water supply."

For a period of 8 years from the time the institution was formally opened (1931) until the epidemic occurred in August, 1939, the Department of Public Health analyzed a total of 241 water samples, collected in 78 separate sets at intervals varying from a minimum of 5 sets to a maximum of 11 sets per year. These water samples were analyzed in the Department of Public Health laboratories in conformance with "Standard Methods of Water Analysis." The accompanying Table III, giving a summary of these results, clearly shows the unsatisfactory bacteriological quality of the supply for the 8-year period prior to the outbreak.

From this tabulation, it will be noted that only during the year 1933 did the supply, from an analytical standpoint, meet the laboratory standards for safe drinking water; also, beginning with 1937, the bacterial quality of the water supply became progressively worse. Gross pollution of the supply is further emphasized by a number of samples collected just prior to and following the outbreak, as shown in Tables IV and V. Each of the 3 consecutive monthly samples from Well No. 4, collected immediately preceding the outbreak, had all five 10 ml. portions positive. Maximum coliform indices, determined on samples collected after the epidemic started, were 70,000 for water from Well No. 4 and 240,000 for Well No. 1.

The laboratory results of all analyses of water samples collected from the institution over the entire 8-year period were reported as soon as completed to the director of the Department of Public Welfare at the State Capitol and to the managing officer at the institution. Conclusions regarding the safety of a water supply are based primarily on the field conditions surrounding the source and the possibilities of pollution through such physical surroundings, therefore, even when occasional satisfactory laboratory results were obtained, the written opinions on these results still stated that the water at the institution could not be considered safe for drinking because of the possibilities of contamination, and reference was then

## TABLE III

## SUMMARY OF RESULTS OF WATER ANALYSES

### Previous to Epidemic

| Year | Number Samples | Collected During Months | Number 10 ml. Portions Tested | Number 10 ml Portions Positive | % Positive Portions |
|---|---|---|---|---|---|
| 1931 | 40 | Feb., Mar., May, June, July, Aug., Sept., Oct., Nov., Dec. | 200 | 80 | 25.0 |
| 1932 | 35 | Jan., Feb., Mar., Apr., May, June, July, Sept., Oct., Nov., Dec. | 175 | 37 | 21.1 |
| 1933 | 15 | Jan., Mar., May, July, Oct. | 75 | 2 | 2.7 |
| 1934 | 28 | Jan., Mar., Apr., June, Aug., Sept., Oct., Nov | 140 | 33 | 23.6 |
| 1935 | 36 | Jan., Feb., Mar., Apr., July, Aug., Sept., Nov., Dec. | 180 | 41 | 22.8 |
| 1936 | 21 | Feb., Mar., May, June, July, Nov., Dec | 105 | 20 | 19.0 |
| 1937 | 26 | Feb., Apr., May, Aug., Sept., Oct., Dec | 130 | 48 | 36.9 |
| 1938 | 15 | Feb., Mar., July, Aug., Oct. | 75 | 30 | 40.0 |
| 1939 | 25 | Jan., Feb., Mar., Apr., May, June, July, Aug. | 125 | 69 | 55.3 |

made to previously submitted formal reports in which details of the hazards and recommendations for correction had been included. When results of analyses showed the water to be bacteriologically unsafe, not only did the written opinion state this but the opinions on the analyses were so worded that the fact that the water supply was not considered safe for drinking should have been clearly understood by any lay person. Some of the actual phrases used in these laboratory opinions were "Unsafe to drink," "This sample represented a water unsafe for drinking," "This was not safe to drink as represented by this sample," "This water is subject to dangerous contamination and not safe to drink," "So great is the danger that at any moment a dangerous water-borne epidemic might result . . .," and "The fact that no epidemic of illness attributed to the water supply has occurred is no indication or proof that such an epidemic may not occur at any time."

## TABLE IV

## MANTENO STATE HOSPITAL

### Bacteriological Analyses of Water Supply

From March 23, 1939, to March 31, 1940

### Well No. 4

(Unchlorinated)

| Month | No. of Samples | Coliforms in 10 ml. Portions or No. of Samples Showing Contamination | Max. Coliforms in any 1 Sample | Average Coliforms per 100 ml. (MPN) |
|---|---|---|---|---|
| March 23 | 1 | 5— | — | — |
| April 27 | 1 | 5— | — | — |
| May 25 | 1 | 5+ | — | — |
| June 1 | 1 | 5+ | — | — |
| August 2 | 1 | 5+ | — | — |
| August 21 | 2 | 2 | 1,300<br>620 | — |
| August 23 | 1 | 1 | 2,400 | — |
| August 26 | 1 | 1 | 2,400 | — |
| August 27 | 1 | 1 | 2,400 | — |
| August 29 | 1 | 1 | 24,000 | — |
| August 30 | 1 | 1 | 24,000 | — |
| August 31 | 1 | 1 | 13,000 | — |
| September | 27 | 24 | 70,000 | 5,889 |
| October | 16 | 11 | 620 | 156.5 |
| November | 28 | 26 | 620 | 105 |
| December | 26 | 25 | 13,000 | 900 |
| January | 28 | 26 | 2,400 | 220.5 |
| February | 27 | 15 | 8.6 | 2.2 |
| March | 12 | 4 | 2.1 | 0.7 |

Note: Dilutions not made previous to August 21. Therefore, maximum coliforms not available for samples collected before that date.

SEWER LEAKAGE. Inasmuch as some of the institution sewers were known to be laid in the creviced limestone and in view of the above outlined history of pollution of the water supply, an attempt was made to trace pollution from the sewers to the water supply. On August 22, a Department of Public Health sanitary engineer learned from a plumber employed by the institution that, a short time before, a sanitary-sewer stoppage had occurred in the sewer on First Street directly in front of Silvis Hall, and that the stoppage had been removed. Upon examination at this approximate location, it was found that a storm sewer paralled the sanitary sewer at a distance of about 10 to 15 feet, and that domestic sewage was flowing in the storm sewer. Both sewers were reported to be laid in creviced

## TABLE V

## MANTENO STATE HOSPITAL

### Bacteriological Analyses of Water Supply

From August 21, 1939, to March 31, 1940

| Month | No. of Samples | No. Showing Contamination | Max. Coliforms in any 1 Sample | Average Coliforms per 100 ml. (MPN) |
|---|---|---|---|---|
| **Well No. 1** | | | | |
| Aug. 21–31 | 1 | 1 | 2,400 | 2,400 |
| Sept. | 7 | 4 | 6,200 | 3,000 |
| Oct. | 30 | 23 | 2,400 | 528.5 |
| Nov. | 24 | 24 | 21,000 | 1,903 |
| Dec. | 15 | 15 | 240,000 | 23,147 |
| Jan. | 21 | 20 | 24,000 | 2,282 |
| Feb. | 27 | 23 | 64 | 17.2 |
| Mar. | 8 | 6 | 240 | 65.2 |
| Total Well No. 1 (Aug. 21–Mar. 31) | 133 | 116 | 240,000 | 3,610 |
| **Well No. 2** | | | | |
| Total Well No. 2 (Aug. 21–Mar. 31) | 73 | 2 | 8.6 | 0.23 |
| **Well No. 3** | | | | |
| Total Well No. 3 (Aug. 21–Mar. 31) | 153 | 4 | 17 | 0.25 |
| **Well No. 4*** | | | | |
| Total Well No. 4 (Aug. 21–Mar. 31) | 172 | 139 | 70,000 | 1,461.7 |
| **Distribution System (Chlorinated)** | | | | |
| Aug. 21–31 | 21 | 5 | 2,400 | 344.40 |
| Sept. | 78 | 2 | 14.5 | 0.21 |
| Oct. | 105 | 2 | 2.1 | 0.02 |
| Nov. | 100 | 0 | 0 | 0 |
| Dec. | 90 | 0 | 0 | 0 |
| Jan. | 53 | 0 | 0 | 0 |
| Feb. | 55 | 0 | 0 | 0 |
| Mar. | 63 | 0 | 0 | 0 |
| Total Dist. System (Aug. 21–Mar. 31) | 565 | 9 | — | — |

Note: All samples from wells collected before any treatment. Double chlorination on water pumped to distribution system began August 25.

*Monthly breakdown of samples for Well No. 4 given in Table IV.

limestone at this location. In order to check the possibility that leakage was taking place from one sewer to the other by passing through crevices in the limestone, flourescein dye was placed in toilet bowls in Silvis Hall and the toilets flushed repeatedly for a period of approximately 15 minutes. Within a very short time this green dye appeared in the sanitary sewer, and in about 15 minutes it was noticed in considerable concentration in the parallel storm sewer. Insofar as could be determined at this location and upstream from this point, there were no direct sanitary connections to the storm sewer. In that there was a time lag of about 15 minutes between the appearance of the dye in the sanitary sewer and the storm sewer, the test demonstrated with reasonable assurance that sewage was flowing from the sanitary sewer through the limestone to the storm sewer. This particular location, where the dye test was made, is approximately 2,400 feet from Well No. 4; however, sewers are laid in limestone to within approximately 400 feet of Well No. 4.

Further checking of the storm-sewer system revealed that the storm sewer from the north (or male) side of the institution was practically dry, as it should have been because there had been no recent rain, while the storm sewer from the south (or female) side of the institution was carrying sewage to a depth of approximately 5 inches above the sewer invert. Determination that the storm sewer was carrying waste of sanitary character was made by visual inspection, the flow having the normal appearance of domestic sewage. Some of this flow may have originated from the basement and floor drains, which were known to have been connected to the storm sewer at some points below that location where the dye test, above-mentioned, was made. However, it is significant that the glacial drift is very thin, and entirely absent at several points on the south half of the institution grounds. Many of the sewers on this side were laid in or on the creviced limestone, while the glacial drift on the north side is somewhat thicker and sewers there were generally bedded in clay.

At the time of this sewer-system investigation (August 22), a stoppage of a sanitary sewer was discovered which sewer was located in the street between the power house and Well No. 4 at a distance of approximately 35 feet from the well. This sewer was of ordinary vitrified clay pipe, with cement-joint construction. Stoppage at some point downstream in the sanitary sewer caused sewage to back up into the sewer until there was a depth of 30 inches in a manhole approximately 80 feet from Well No. 4. Thus, through an inspection by a responsible Department of Public Health sanitary engineer, it was determined that a sanitary sewer in the near vicinity of Well No. 4 (from which the entire institution water supply had been obtained for several weeks prior to the epidemic) was surcharged with sewage under considerable pressure; and although the sanitary sewer at this location was not laid directly in the limestone, there being approximately 12 feet of clay intervening between the invert of the clogged sewer and the top of the creviced limestone, this finding gave further substantiation to the probability that sewage pollution had entered the institution water supply.

ISOLATION OF *E. TYPHOSA* FROM WATER SUPPLY. From the above finding it was concluded that sewage pollution might actually be then passing from the surcharged sewer directly to the limestone and Well No. 4. Therefore, it was determined to make the attempt to isolate

typhoid organisms directly from the raw water produced from Well No. 4. In most instances it is not possible to isolate typhoid organisms from water supplies suspected of harboring this organism; in fact, this can be done so rarely that it is usually not attempted. However, in view of the long record of unsatisfactory bacteriological results obtained on samples collected from the supply, which indicated that water from Well No. 4 was grossly polluted, it was considered worthwhile to attempt the isolation of *E. typhosa* from this well. This attempt was begun on August 22, the identification being completed on August 31, 1939. The method employed being an unusual one, we present here the technique and results as given in the Department of Public Health bacteriologist's original report:

> "Approximately 6 quarts of water were obtained from the sampling faucet of Well No. 1, and the same amount in two instances from Well No. 4, (sterile Erlenmeyer flasks). In each instance approximately 6 quarts of water were filtered through a Seitz filter pad, size E. K., and this pad was subsequently broken up in 250 cc. Selenite F. enrichment. Incubation time of filter pad from Well No. 1—18 hours. Incubation time of filter pad from Well No. 4 was, on my first attempt, 18 hours and at my second attempt from the same well 8½ hours, (when typhoid bacilli were isolated). The reason for changing incubation time was that after plating on Endo agar from the Selenite the Endo plates showed heavy overgrowth of organisms belonging to colon-aerogenes group.
>
> "After incubation in Selenite, one 7 mm. loop was streaked each time on each of 5 Endo agar plates and incubated overnight. In my second attempt with water from Well No. 4, two colonies were picked having the following characteristics: dextrose acid, mannite acid, arabinose, rhamnose, saccharose, lactose no change and xylose acid. The organism was indol neg., $H_2S$ very pronounced (noticeable after 5 hours) in lead Motility agar, Gram neg., motile, agglutinated readily in typhoid immune serum ( 2 hours at 37.5°C.) in a dilution of 1:640 (floccular agglutination)."

The reactions of the organisms as described in the above report are typical of those produced by typhoid organisms in every respect. There appears to be no doubt, therefore, that typhoid organisms were present in the water from Well No. 4 at the time the sample was collected.

In considering this unusual isolation of typhoid fever organisms from the water of Well No. 4, it should be recalled that there is much evidence to show that the water was grossly polluted and therefore *E. typhosa* was probably present in the sample collected. Table IV gives bacteriological results of analyses of samples collected from Well No. 4 for several months before and after the epidemic. It will be observed that coliform indices on August 21 (the day before collection of the samples from which *E. typhosa* was isolated) were 1,300 and 620. On the day after, August 23, the coliform index was 2,400. The coliform index reached a maximum of 70,000 in September. Unfortunately, dilutions were not made on the samples collected previous to August 21, and therefore coliform indices are not available to show the exact numerical degree of pollution of Well No. 4 during the period immediately preceding the outbreak;

however, the confirmed positive results (5+ on 10 ml. portions) for that period do show gross pollution.

ADDITIONAL POLLUTION SURVEY. While the attempt was in progress to isolate typhoid fever organisms from the institution water supply, Department of Public Health sanitary engineers proceeded to make additional investigations to substantiate more fully pollution of the water supply. An attempt was made to trace pollution from the sewers into Wells No. 1 and No. 4. For purposes of tracing sewage pollution from the sanitiary sewers into the wells, the use of salt and fluorescein was adopted. These tests were conducted on August 29 and 30.

Salt was applied to 10 sewer manholes, located at different points on the sanitary sewer system. These points are shown on the map of the institution which is presented in this report as Fig. 1. At each manhole approximately 10 pounds of medium-grade granulated salt were added directly to the sewer and a 10-pound sack of rock salt was placed in the invert of the flowing-through channel of these manholes, thus blocking the normal passage and causing the sewage level to rise and pass over and around the salt sack. Rock salt was used in order to effect a gradual dosage of chlorides following the initial dose of granulated salt. Altogether about 200 pounds of salt were added to the sewer system.

Fluorescein dye was also added to the sanitary sewers at 7 manholes by the use of 54-gallon barrels, each equipped with stopcocks so that the solution of fluorescein and water could be added over a period of time. Approximately 100 grams of dye were added to each 50 gallons of water in the barrels, the dye solution being allowed to drip in a steady, thin stream directly into the sewer invert channels of the manholes. A total of about 1½ pounds of fluorescein was added. From Fig. 1, which shows the points of application of fluorescein to the sewers, it will be noticed that the fluorescein was applied principally to the sewers covering the south side of the institution, this being done because it was learned that these sewers were generally laid directly on or in the creviced limestone formation.

The tests were conducted for 24 hours, during which period determinations of both chloride and fluorescein contained in Wells No. 1 and No. 4 were made. Initial chloride determinations were made prior to the dosing of the sewer system, which established the initial chloride content of water from both Wells No. 1 and No. 4 as approximately 14 parts per million. The general procedure was adopted of collecting samples from both wells after one hour of pumping, so that representative results could be obtained. Fluorescein determinations were made by use of 100 ml. Nessler tubes, in which periodic samples were checked colorimetrically against initial samples. Table VI is a complete tabulation of determinations made during these tests, and Fig. 4 graphically shows the results of the salt test.

On the chloride determination made one hour after the sewer system was dosed, it will be noted that an increase of approximately 10 parts per million of chlorides was determined. This determination was made following the starting of pumpage from Well No. 4 and appears to be false since during the previous hour difficulty was experienced with the well, and although the pump was running no water was being lifted. Immediately prior to the sample collection for this determination, the pump was shut down and apparently a back-siphonage of chlorinated lime into the well was experienced

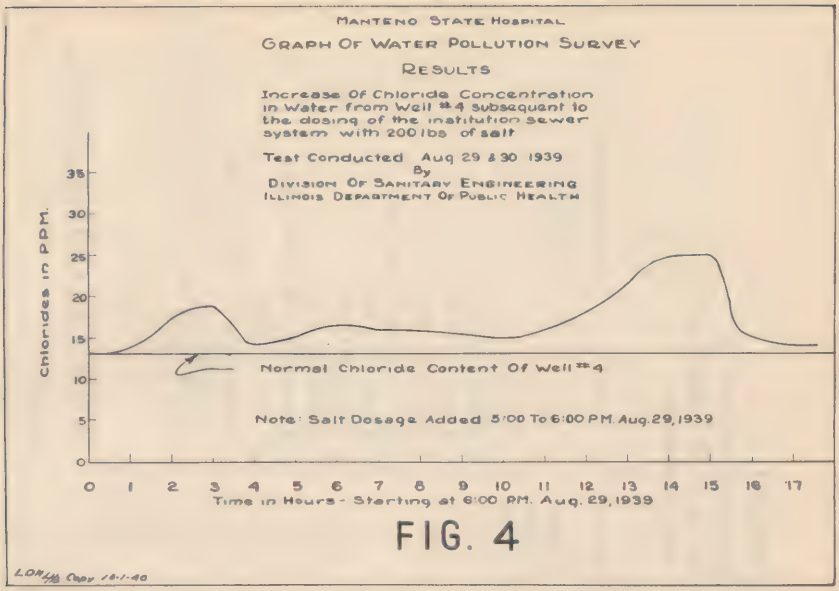



FIG. 4

which gave this false reading. All other determinations were made following at least a full hour of pumpage, and a study of Fig. 4 indicates that the most positive chloride increase occurred about 14 hours subsequent to the dosing of the sewers with salt. After a period of 6 hours had elapsed following the salt dosage, an inspection of the sewer manholes in which the bagged rock salt had been placed revealed that nearly all of the salt had dissolved and passed on into the sewer system; and, since at this time a positive increase of chlorides was noted, the fluorescein dye dosage was increased so that the remaining dye would pass through the sewers within another hour's time.

At no time during the test was the presence of fluorescein found in the water from either Well No. 1 or Well No. 4. Results, however, of chloride determinations for Well No. 4 showed increases of chloride content, particularly at intervals of 1, 6, and 14 hours after the dosing of the sewers with salt. From these tests it was concluded that a positive increase of chlorides in the water pumped from Well No. 4 indicated, beyond reasonable doubt, that sewage pollution was entering this well.

## TABLE VI

## MANTENO STATE HOSPITAL

Water-supply pollution survey to check possible increase of chloride concentration and presence of dye in wells following dosing of sewer system with salt and fluorescein.

TABULATION OF RESULTS

| Sample No. | Time | Well No. | Test by | Ml. of sample | Ml. of $AgNO_3$ | Chlorides ppm | Fluorescein color | REMARKS |
|---|---|---|---|---|---|---|---|---|
| Initial..... | — | 4 | Div. Lab. | — | — | 14.0 | — | August 21, 1939 |
| " ..... | — | 4 | " " | — | — | 16.0 | — | August 23, 1939 |
| " ..... | — | 4 | " " | — | — | 14.5 | — | August 26, 1939 |
| " ..... | — | 4 | " " | — | — | 22.5 | — | After starting pump August 27 |
| " ..... | — | 4 | RMB | 50 | 1.4 | 14.0 | 0 | August 29, 1939 |
| " ..... | — | 4 | " | 50 | 1.25 | 12.5 | 0 | August 29, 1939 |
| " ..... | — | 1 | " | 50 | 1.55 | 15.5 | 0 | August 29, 1939 |
| " ..... | — | 1 | " | 50 | 1.50 | 15.0 | 0 | August 29, 1939. Initial check |
| " ..... | — | 2 | " | 50 | 1.00 | 10.0 | 0 | August 29, 1939 |
| " ..... | — | 2 | LEW | 50 | 1.05 | 10.5 | 0 | August 29, 1939. Initial check |
| 1..... | 6:00 P.M. | 1 | RMB | 50 | 1.30 | 13.0 | 0 | |
| 2..... | 7:00 P.M. | 4 | " | 50 | 2.25 | 22.5 | 0 | Reading taken after starting pump. Result checked |
| 3..... | 8:00 P.M. | 1 | " | 50 | 1.35 | 13.5 | 0 | |
| 4..... | 9:00 P.M. | 4 | LDH | 50 | 1.90 | 19.0 | C | |
| 5..... | 10:00 P.M. | 1 | " | 50 | 1.5 | 15.0 | 0 | Wells No. 1 and No. 4 pumped entire hour |
| 6..... | 10:00 P.M. | 4 | " | 50 | 1.4 | 14.0 | 0 | |
| 7..... | 11:00 P.M. | 4 | " | 50 | 1.5 | 15.0 | 0 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 8 | 12:00 A.M. | 4 | " | 50 | 1.6 | 16.0 | 0 | |
| 8 | 12:00 A.M. | 4 | " | 50 | 1.7 | 17.0 | 0 | Result checked |
| 9 | 12:00 A.M. | 1 | " | 50 | 1.4 | 14.0 | 0 | |
| 10 | 12:30 A.M. | 4 | " | 50 | 1.6 | 16.0 | 0 | August 30, 1939 |
| 11 | 1:00 A.M. | 4 | " | 50 | 1.6 | 16.0 | 0 | |
| 12 | 2:00 A.M. | 1 | " | 50 | 1.35 | 13.5 | 0 | |
| 10 | 12:30 A.M. | 4 | RMB | 50 | 1.70 | 17.0 | 0 | Result checked |
| 13 | 3:00 A.M. | 4 | " | 50 | 1.53 | 15.3 | 0 | Fluorescein dosage increased between 3:10 and 3:40 A.M. |
| 14 | 4:10 A.M. | 4 | " | 50 | 1.5 | 15.0 | 0 | |
| 15 | 8:00 A.M. | 4 | " | 50 | 2.50 | 25.0 | 0 | |
| 16 | 8:30 A.M. | 4 | LEW | 50 | 2.5 | 25.0 | 0 | |
| 17 | 9:00 A.M. | 4 | " | 50 | 2.5 | 25.0 | 0 | |
| 18 | 9:30 A.M. | 4 | " | 50 | 1.73 | 17.3 | 0 | Checked O.K. |
| 19 | 10:00 A.M. | 4 | " | 50 | 1.5 | 15.0 | 0 | |
| 20 | 10:30 A.M. | 4 | " | 50 | 1.45 | 14.5 | 0 | |
| 21 | 11:30 A.M. | 4 | " | 50 | 1.4 | 14.0 | 0 | |
| 22 | 12:30 P.M. | 4 | " | 50 | 1.4 | 14.0 | 0 | |
| 23 | 1:00 P.M. | 1 | " | 50 | 1.5 | 15.0 | 0 | Well idle since 4:00 A.M. Two minutes' pumping |
| 24 | 1:30 P.M. | 4 | LDH | 50 | 1.65 | 16.5 | 0 | |
| 25 | 2:00 P.M. | 1 | " | 50 | 1.4 | 14.0 | 0 | After 45 minutes of pumping |
| 26 | 2:30 P.M. | 4 | LEW | 50 | 1.4 | 14.0 | 0 | |
| 27 | 3:30 P.M. | 4 | " | 50 | 1.4 | 14.0 | 0 | |
| 28 | 4:30 P.M. | 4 | " | 50 | 1.4 | 14.0 | 0 | |

## CHAPTER V

# CONTROL METHODS ADOPTED

After the preliminary observations had been completed, it was obvious that additional control methods would have to be adopted immediately in order to prevent the further spread of typhoid fever. The measures which were deemed essential were: more stringent isolation of typhoid patients, better food-handling methods, proper disposal of typhoid wastes, improved methods of handling linen, insect- and rodent-control, adequate chlorination of water, chlorination of sewage, immunization, and a carrier finding survey.

STRICT ISOLATION. In inaugurating control measures at the institution, one of the first objectives was to reduce, as far as possible, the chances of inmates' and employees' contracting typhoid fever as a result of direct contact. This, of course, necessitated the adoption of strict isolation and quarantine measures. Since typhoid fever is a disease which has a slow onset with varied symptoms, definite diagnosis often cannot be made during the early stages. It was recognized, however, that persons in the early stages of the disease are capable of transmitting the disease to other individuals; hence, isolation wards were established in the west wing of the hospital for the segregation of all persons showing any symptoms whatsoever like those of typhoid. These suspected cases were held in isolation in this ward until they were either definitely proved not to have typhoid or proved by either clinical or laboratory findings to have the disease.

Since the general hospital had a capacity of only 200 beds, with 100 of these already being used for general medical and surgical cases, it was found impossible to care for the large number of typhoid and suspected-typhoid inmate patients in this place. Therefore, two of the single-story "I"-type cottages were set aside as typhoid wards; namely, Clouston and McDowell, used for male and female patients, respectively. Since these cottages were not primarily planned for the care of acutely ill patients, there was no hospital equipment available. Therefore, articles which were essential for the care of sick patients, such as hospital beds, rubber sheets, hot-water bottles, rectal tubes, and enema and venoclysis apparatus, had to be supplied. Since typhoid patients occupied all parts of these buildings, persons other than those who had business in the buildings were, of necessity, excluded.

Hospital employees who became ill with typhoid were hospitalized in single and double rooms located on the second floor of the general hospital building. These rooms were adjacent to the rooms used for the isolation of suspected-typhoid inmate patients; and, therefore, isolation technique was applied to the entire area as a unit. Unfortunately, the diet kitchen serving the second floor of the hospital building was located within the isolation area. Since general medical and surgical patients also located on the second floor had to be served from this kitchen, it was essential that this room be maintained as a clean area, and much difficulty was experienced in the serving of food from this kitchen to both typhoid patients and the general medical and surgical patients. This difficulty was overcome by

several means. All persons were excluded from the kitchen except dietary personnel who were not allowed to enter the isolation area. The kitchen fortunately was provided with two entrances at opposite ends of the room. All foods served to the typhoid patients were served through one doorway, which was blocked by a serving table. The food was poured from the kitchen containers into separate containers which were kept for the use of the isolated patients. During the transfer of the food from one container to another, there was never any contact between them. Dishes from the isolation ward were not taken into the diet kitchen without first being thoroughly sterilized. The food to be served to the clean area on the second floor was transported on a food cart through the outer entrance of the kitchen to the general medical and surgical wards without coming in contact with the isolation section of the hospital.

CONCURRENT DISINFECTION. A routine process of concurrent disinfection was established for all of the isolation wards. Every person whose duties required his presence in an isolation unit was required to wear a surgical gown to protect his outer clothing. Hand-washing facilities were provided and available at the exit from all isolated areas. These facilities consisted of a double-basin washstand, the first basin containing 2 quarts of water, 2 teaspoonfuls of compound cresol solution, and sufficient green soap to provide a good lather. Any person leaving the isolation unit scrubbed his hands thoroughly, using a scrubbing or nail brush and cleaning thoroughly under the fingernails in the solution provided in the first basin. In the second basin there was a rinse solution, consisting of 2 tablespoonfuls of compound cresol to 2 quarts of water. The hands were then dried with clean paper towels. Linen towels were not used, since it was considered important that each towel be disposed of after being used. After the hands were washed, the surgical gown was removed, folded inside in, and hung by the shoulders on a hook. This kept the inside of the gown uncontaminated. In putting on the gown, the wearer slipped his hands, palms together, between the back edges of the gown and grasped the inside; the gown was then removed from the hook and the hands forced through the sleeves and cuffs. The hands did not touch the outside of the gown during this procedure. Since the door handles were contaminated, paper towels were provided at the door for the purpose of grasping the door handle. These towels were then disposed of by burning.

In order to carry out the various duties in the typhoid wards, an attempt was made to have a graduate nurse, with special contagious-disease training on duty for every shift. This nurse was responsible for the supervision of the nursing procedures carried out by the ward attendants.

All articles used in the care of typhoid patients were carefully disinfected after each use. Rectal tubes, colon tubes, etc., were scrubbed with soap and water, then soaked in a 1-200 bichloride of mercury solution for 20 minutes, and placed in actively boiling water for 20 minutes. Enema apparatus was disconnected after each use and the rubber tubes and tips were disinfected as mentioned above for rectal tubes. The enema cans were disinfected through the use of strong compound cresol solution such as was used for the care of bedpans. Both rectal and oral thermometers were washed in soap and water and then passed through a 1-1000 mercuric bichloride solution or a 5% phenol solution with 70% alcohol rinse. These

thermometers were required to remain in either of the above-mentioned solutions for 5 minutes, and were thoroughly rinsed with water before they were used again.

Intravenous tubing and needles were stored in the various isolation wards and were sterilized after each use by boiling.

TERMINAL DISINFECTION. All equipment which was to be removed from the typhoid wards for any reason received special attention. Beds were taken apart, moved outside the isolation unit, there thoroughly washed with a 10% compound cresol solution, and allowed to dry in the open air for several hours. Contaminated pillows and mattresses were rolled in clean sheets, removed from the ward on a special truck, and delivered directly through an outside door into the sterilizing room in the basement of the Diagnostic Building, where they were sterilized with steam and formaldehyde. Woolen or leather articles, such as patients' clothing, which would be damaged through contact with a strong chlorine solution or steam, or by boiling, were disinfected by being exposed to formaldehyde gas in a tightly closed container for at least 24 hours. Similar sterilizing procedures were carried out by injecting atomized formaldehyde solution into a heated steam sterilizer, but without the use of steam in the chamber.

QUARANTINE. In order to minimize the possibility of infection by contact with subclinical cases, all moving-picture shows, dances, church services, and gatherings of any kind where patients from the various wards came in contact with each other, were stopped.

Due to the fact that hundreds of friends and relatives swarmed into the institution week ends and holidays, it was deemed necessary for the protection of these people to ban all visitors from the institution. This was accomplished by posting guards and signs at all entrances to the grounds. No more committed or voluntary patients were admitted to this institution during the epidemic. Also, the importation of all food from the outside by individuals was stopped, other than that in the original containers in which it was merchandised.

FOOD HANDLING. Since one of the principal means of transmission of typhoid fever is contaminated food, one of the very first control measures adopted by the Department of Public Health in combating this epidemic was the effort to obtain at least two postcathartic specimens of feces and urine from each food handler in the institution, to be examined for the presence of typhoid or paratyphoid organisms. When any of these specimens was found to be positive, the person submitting that specimen was promptly removed from any food-handling capacity.

Special precautions were taken in the handling of food for the two typhoid wards and the hospital by having one truck deliver the food to these three points. Instructions were given that the truck personnel were not to enter the typhoid-isolation-ward kitchen nor to take central-kitchen food cans into that room. All food was transferred outside the kitchen door from the central-kitchen containers on the truck directly into the ward-kitchen containers without their contacting each other. The food containers on the truck were then taken to the basement of the central kitchen, where they were washed and subjected to live steam for a period of 2 minutes before being returned to the central kitchen proper.

As an additional precaution, an attempt was made to maintain the kitchens at the isolation wards and the hospital as clean areas. In other words, no food containers or materials were allowed to enter the isolation kitchen until they had been thoroughly and completely sterilized by chlorine solution. Aluminum plates, cups, and other utensils that were used by the typhoid patients for eating were cleaned, and then soaked in a chlorine solution 500 parts per million for 30 minutes before they were taken to the kitchen and put through a dishwashing machine which had live steam available for sterilization. Milk bottles, pop bottles, and similar containers were kept in the typhoid isolation ward and stored in a wooden barrel until the barrel was filled. The bottles were placed neck up, and when the barrel became full a chlorine solution having 100 parts per million of available chlorine was applied; the bottles were left overnight in this solution before they were removed from the building.

Employees in the isolation-ward kitchen, before entering the ward or dining room thereof, put on surgical gowns; and, upon returning to the kitchen, they were required to remove the gown and thoroughly and completely wash their hands with green soap and a compound cresol solution. Inmate workers in the isolation-unit kitchen and dining room were isolated the same as the workers on the feces-collection detail and were given the same treatment as far as clothing, bathing, etc., were concerned.

Rubbish from the isolation ward, such as papers, paper towels, and other combustible material, was burned at the ward, and special precautions were taken to see that none of this material was left in the improvised incinerator at the ward; tin cans were charred before they were removed to the rubbish dump.

FECAL AND WASTE DISPOSAL. No sewage, wash water, bath water, or any other waste was allowed to enter the institutional sewer from the typhoid-isolation units because of the leakage from the sanitary sewer into the creviced limestone and the inadequacy of treatment facilities available at the institution sewage works. All body wastes from the typhoid patients were collected in bedpans, urinals, or commodes; and, after being emptied into the fecal cans located in the utility room, these containers were scrubbed with, and placed in, a solution having approximately 500 parts per million of free chlorine. After remaining in this solution for a period of 30 minutes, the bedpans, urinals, commodes, and bed chambers were rinsed and then hung on pegs and allowed to dry. This practice caused marked irritation of the skin over the buttocks, thighs, and back; and in many instances this irritation, with the combined effect of pressure, resulted in decubitus. Upon examination of the bedpans it was found that, regardless of the extent of rinsing, there was a remaining film of lime deposited on the rims of the bedpans. To eliminate this difficulty, green soap and 2% compound cresol were substituted for the chlorine. The solution used for this cleansing and sterilizing was composed of one gallon of compound cresol, U.S.P., to 50 gallons of water. To this were added 2 cupfuls of green soap or a similar quantity of soap chips.

Whenever this sterilizing solution or the subsequent rinsing solution became dirty or contained a visible amount of fecal matter these solutions were changed, the dirty solution being disposed of in the same manner as

feces, urine, garbage, etc. The substitution of the cresol solution for the chlorine solution in the concurrent disinfection of the bedpans, urinals, and commodes, resulted in a marked decrease in the decubital ulcers.

All fecal matter, urine, bath water, uneaten food, and other wastes coming from the typhoid patients were collected in 25-gallon galvanized iron cans in which 2 cupfuls of chlorinated lime, having 30% available chlorine, had been sprinkled on the bottoms of the cans before receiving any wastes, and it was a standing order that whenever the lid of a fecal can was removed there should always be a strong chlorine odor. This meant that several cupfuls of chlorinated lime had to be added to the can before it was finally filled. Fecal cans were never filled more than about two-thirds full so that they could be easily handled without spilling the material in the process of transportation to the fecal-disposal field.

After treatment with chlorinated lime in the isolation ward and the hospital, the fecal cans were removed to a fecal-disposal field where the material from the cans was placed in 90-gallon caldrons and was then boiled until a thick paste residue was left in the caldron. This material was removed from the caldron, thrown directly onto the fire, and burned—thereby eliminating any possibility of transmitting typhoid fever from this waste material. Fecal cans were cleaned with a strong solution of chlorinated lime, having 1,000 parts per million of available chlorine. All of the fecal material was transported on one truck, used for no other purpose, and at the end of the day this truck was washed down with a 10% compound cresol solution. Hospital employees were not available for performing duties in gathering wastes from the typhoid wards and it was necessary to use patient labor; these patients were isolated in the same manner as typhoid cases, in a separate building, and they were not allowed to mingle with other patients of the institution. Also, the clothing worn by this detail was treated in the same manner as soiled linen from the typhoid wards. These patients were all bathed and given a change of clean clothing twice a day; namely, at noon when they came in to eat, and in the evening before dinner.

At the fecal-disposal field proper, the work, again, was done by inmate labor under the supervision of an attendant and the same procedure was followed with these inmate workers as had been outlined above for the fecal detail.

The efficiency of the measures adopted for the handling of this highly infectious material was clearly demonstrated in that at no time during and subsequent to the epidemic did any of the inmates or employees working on the detail mentioned above develop typhoid fever; however, all had received typhoid vaccine. Hand-washing facilities were provided at all points where the detail handled fecal cans, and they were compelled to wash their hands thoroughly in a compound cresol solution, using green soap, after handling the cans. Paper towels were used for drying hands and were disposed of by burning.

LINEN AND LAUNDRY HANDLING. To prevent the exposure of soiled laundry to flies, roaches, and other insects, rolling hampers were provided so that linens removed from the patients' beds were placed directly in the hampers and not allowed to be left on the floor. The hampers of linen were taken to the bathroom, where galvanized iron cans of approximately 25-gallon capacity were used for receiving the soiled linen. These

cans were of a different design from those mentioned above for the disposal of fecal matter, urine, and other body wastes so that they would not be confused with the latter cans. In the 25-gallon cans a chlorine solution was provided which had approximately 100 parts per million of free chlorine; and the linen, after being placed in the can, was submerged and allowed to set for a period of 4 hours before it was transferred from the typhoid ward to the laundry. During the early part of the epidemic, chlorinated lime was placed directly in each can and water added, but it was found that this procedure resulted in the disintegration of a large quantity of linen. To eliminate this difficulty, a stock solution of chlorinated lime was mixed in a 55-gallon barrel so that the solution had 1,000 parts per million of available chlorine. The supernatant liquid from this stock chlorine-solution barrel was placed in the galvanized iron cans and diluted to approximately 100 parts per millon. However, during the early part of the epidemic, a much stronger chlorine solution was used for the linens, due to the fact that the majority of the linens were badly soiled. This resulted in the disintegration of a considerable amount of linen. However, it was felt that this procedure was justifiable. Checks were made by engineers from time to time to ascertion the residual chlorine in the linen cans after a 4-hour storage period, and the chlorine dosage was reduced in accordance with the findings of these check results.

The linen from the isolation wards was transported to the laundry by the laundry detail, one truck being assigned to this duty and used for no other purpose. Upon arrival at the laundry, where one washing machine was set aside for the washing of linens from all typhoid wards, the galvanized iron cans were removed and their contents discharged directly into the washing machine by the laundry detail; the cans were brought out immediately and placed on the laundry-detail truck without sitting around the laundry. All laundry from the typhoid wards was returned to those wards after being cleaned.

The laundry detail was segregated from the rest of the inmates of the institution in the same manner as the other patient-help working in connection with the typhoid wards, and at the close of each day the laundry truck was washed down with a 10% compound cresol solution.

Any colored materials, woolens, or leather goods which would be damaged by the chorine solution were disinfected by placing them in galvanized iron cans with tight-fitting lids. In the bottom of each of these cans was placed one ounce of 40% formaldehyde. The articles to be disinfected were allowed to remain in the cans in the formaldehyde fumes for 24 hours, after which they were removed and placed in clean pillowcases and taken from the ward without contacting any contaminated surface.

INSECT AND RODENT CONTROL. All known fly-breeding places were eliminated: (1) by having fly-breeding material removed, if possible; (2) by spreading chlorinated lime over the area where the objectionable conditions had existed. In the case of the screenings pit near the sewage-treatment plant, two loads of straw were deposited on the screenings and the maggots killed by burning the straw, then approximately 8 inches of earth were placed over this material so that there was no organic material exposed.

Very little attention had been paid to the elimination of flies in the various buildings by spraying or by proper screening, and it was necessary to see that all screens, especially those in the typhoid wards and the kitchens of the institution were placed in first-class condition. In addition, nightly spraying with a good insecticide and the placing of fly strips in all buildings of the institution were resorted to with excellent results.

For some time after killing frosts had occurred at the institution there was still need for fly control in the various ward buildings and the kitchens. Fly strips were maintained in the wards and kitchens at all times.

Large blast fans were purchased and placed in the typhoid isolation wards and in the central kitchen so that the blast struck the outside door, which assisted in preventing the entrance of flies.

A contract was made with a commercial exterminating company, and, by means of an intensive program, the cockroach nuisance wes eliminated.

The rodent population at the institution was materially reduced through the education of employees, the provision of new garbage cans with tight-fittng lids, and the elimination of garbage and sewage-screenings dumps.

CHLORINATION AND CONTROL OF WATER. A pulso-meter-type chlorinator was installed at the institution on Saturday, August 19. This chlorinator introduced chlorine into the water just ahead of the high-service pumps on the suction line from the reservoir.

Samples of water, collected from the kitchen of the institution, showed that the water was still contaminated due to the lack of a sufficient chlorine-contact period; and it was necessary to install additional chlorinators so that the water would have a retention period sufficient for killing the organisms present. Until additional chlorinators were installed, batch chlorination of the collecting reservoir was resorted to by using calcium hypochlorite; and all samples collected after August 25, when this type of chlorination was resorted to, showed that the water was free from coliform organisms as it was sent to the distribution system. On August 26, two additional chlorinators were installed (one on the discharge of Well No. 4, and the other on the discharge of Well No. 1). An exceedingly heavy dose was added in both places to compensate for the dilution caused by the water coming to the reservoir from Wells No. 2 and No. 3, which wells were not provided with individual chlorinators.

A chlorine-demand determination was made on the water from Well No. 4, and found to be 0.936 part per million.

Residual chlorine determinations were made at hourly intervals at the power house. Samples were collected and residual chlorine determinations were made daily from fourteen points on the distribution system. The residual chlorine was kept between .75 and 1.0 part per million on the distribution system until the danger of amoebic dysentery was recognized. (See Chapter VI.)

It was found that many attendants and employees of the institution were bringing water to the grounds in containers from outside sources. This practice was ordered stopped because of the possibility of bringing in contaminated water and giving it to the patients.

IMMUNIZATION. One of the first recommendations given to the authorities at Manteno State Hospital, in order to control the typhoid epidemic, was that typhoid immunization should be instituted at once. This procedure was most important, inasmuch as no general typhoid-vaccination program had ever been instituted at the hospital and practically the entire hospital population could be considered susceptible to the disease. Therefore, on or about August 23, a program was instituted whereby the patients in the various wards and all employees started receiving typhoid vaccination. These vaccinations were given by injecting one-half, one, and one ml. portions of typhoid vaccine at 5-day intervals. By Septmber 5, practically every individual in Manteno State Hospital had received 3 doses of typhoid vaccine. Triple vaccine was not used, since it was recognized that this particular preparation caused more severe reactions; and, in this epidemic, paratyphoid did not seem to be of any importance, as was shown by bacteriological procedures.

SPECIMEN COLLECTION. In order to maintain bacteriological control over this epidemic, specimens of blood for cultures were taken from all patients having any symptoms suspiciously like those of typhoid. In certain cases a Widal agglutination test was also made on these blood specimens. The results of this latter test, of course, were not accepted as conclusive in proving that a patient did or did not have typhoid fever. Some of these individuals had received typhoid vaccine, which produced positive results even in the absence of the disease, whereas others who were in their first week of illness showed a negative agglutination test but were definitely proved later to have the disease. Two feces and urine specimens were collected from every person, inmate or employee, in the institution. An effort was made to obtain 3 specimens as soon as possible from every person employed as a food handler.

## CHAPTER VI

## AMOEBIASIS-CONTROL METHODS

On October 13, there was a case of amoebic dysentery reported in the hospital. This case had been proved by a microscopic stool examination. The patient was immediately isolated, and all precautions taken to keep the body wastes from entering the sewer system. However, there was fairly definite evidence of leakage from the sewers into the water supply, which was protected only by chlorination. Recognized water works authorities indicated that *Endamoeba histolytica* cysts were killed only by exceedingly high dosages of chlorine. Therefore, it was felt that in order to eliminate any possibility of an outbreak of amoebic dysentery, drinking water from an outside source should be brought into the institution.

This first patient having amoebic dysentery died on October 16. At a post-mortem held on October 17, the pathologist stated that in his opinion the individual had contracted the disease not more than 4 to 6 weeks previous; and, therefore, since the patient had been in the institution for years, it was certain that he had contracted the disease there.

On October 20, another case of amoebic dysentery was found and the patient isolated. As a result of these two cases all additional persons developing diarrhea were isolated in their respective wards for a period of 48 hours in order to ascertain whether or not the disease would subside spontaneously, and also to allow time for miscroscopic stool examinations to be made for amoebiasis.

On October 22, the first water was hauled into the institution from the Kankakee public water supply by a truck loaned to the Department of Public Welfare by a large Chicago dairy. In addition to this truck, this dairy and one other loaned the institution several hundred milk cans for the distribution of water to all wards of the institution.

Consideration was also given to bringing water in by other methods, such as railroad tank cars, and transporting it directly in 10-gallon milk cans. A study was also made of the possibility of filtering the water through existing pressure filters used for boiler-feed water; also of raising the temperature of all drinking water above the thermal death point of *Endamoeba histolytica* and then cooling with the institutional refrigeration equipment. The method of transportation by truck was finally adopted because it was the most economical, sanitary, and flexible.

Drinking water was dispensed in all buildings by means of 110 wood barrels, which had been paraffined inside and were equipped with brass faucets. Wood paper-cup dispensers were built on the sides of the racks supporting the barrels, since glass cup dispensers could not be used because of the type of patients at the institution. These dispensers were constructed by the institution carpenters.

The Kankakee water supply was taken from the Kankakee River, and treated by means of coagulation, sedimentation, filtration, and chlorination. The finished water supply had a residual chlorine of approximately 0.2 part

per million. As an additional precaution each tank truck load of water was chlorinated during filling so that there was a residual chlorine of 1 to 1.5 parts per million in the water when it arrived at the institution. The chlorine residual was checked and a sample of water for bacteriological analysis was collected from each truck load of water.

A system of distribution was arranged whereby the 10-gallon milk cans, which had been previously placed in the wards, were filled daily directly from the tank truck.

An ample water supply was maintained by having several 10-gallon cans full of water in reserve at all wards. A detail of institution employees and patients was responsible for filling all of the barrels daily. In order to take care of fluctuations in water consumption, a reserve supply was maintained at a central location and was availble upon call, at any time.

The first day the barrels were used for dispensing water, samples were collected from all of the barrels for the purpose of bacteriological analyses. The results of these analyses, which were made in the Springfield laboratory of the Department of Public Health, revealed that the water in many of the barrels was grossly contaminated. Upon investigation, it was found that patients were inserting clothing and other material into the water through the 2-inch bung provided in the top of the barrels for the purpose of filling. As a result it was necessary to protect the water supply by placing hasps and locks on the bungs of all barrels.

In addition, two Department of Public Health engineers collected samples from barrels at various locations, and a routine was worked out so that each barrel was sampled at least once a week. Residual-chlorine determinations were made of the water in all of the barrels daily, and each engineer was given instructions that whenever a barrel was found which had no residual a sample for bacteriological examination was to be collected, regardless of when the last sample had been taken. Engineers were also instructed to add more chlorine, from the stock solution which they carried, to such barrels in order to raise the residual to at least one part per million.

Wherever a ward attendant complained of odor or taste in the water, that barrel was immediately removed and replaced by another barrel.

This same practice was followed when any single barrel was responsible for more than one contaminated sample of water. A practice was also established for the routine cleaning, washing, and disinfection of all barrels. A concentrated solution, having at least 1,000 parts per million available chlorine, was used for disinfecting the barrels.

In the beginning it was felt that it would be necessary to supply approximately 15,000 gallons of water per day for drinking purposes. This figure was grossly in error, and it was found that it was necessary to transport only 2,100 gallons per day to supply the necessary demand.

The original institution water supply was maintained for sanitary purposes and fire protection; however, all drinking fountains throughout the institution were shut off and precautions were taken to see that drinking cups were not provided at any of the distribution-system taps. In addition, the chlorine dosage was increased to approximately 5 parts per million to discourage the drinking of this water.

The amoebiasis cases and suspects were isolated in a separate section of the hospital. Special provisions for carrying out isolation technique for these patients were provided and were similar in nature to those used for the typhoid patients, with the exception that 10% cresol solution was used in place of chlorine for disinfecting body wastes, utensils, etc.

Because of continued suspicion that amoebiasis was epidemic in the institution, a parasitologist from the Division of Laboratories made a Survey of 175 specimens during the period of November 17 to 21, inclusive. Many different parasites were found, including *E. coli* in 51 specimens, but *E. histolytica* were demonstrated in only 2. Although only 2 individuals with *E. histolytica* in their stools were found, there existed the possibility that other carriers were present in the institution; consequently, the precautions already in effect were continued until emergency coagulation and filtration equipment could be installed on the institution water supply. This equipment was placed in operation on March 1, 1940.

The emergency purification equipment consisted of a battery of 8 pressure filters, each 96 inches in diameter. They were inserted in the discharge line from the high-service pumps. Alum and acid-treated sodium silicate were used to effect coagulation, these chemicals being applied into the pump suction line, the agitation in passing through the pumps effecting quick mixing. There was a theoretical retention period of approximately 8 minutes in the high-service pump piping and in the filter space above the sand, from the time the water was dosed with coagulant until it passed into the filter sand. Laboratory jar tests, conducted while the emergency plant was being designed, showed that none of the common coagulants or any of their combinations would produce a satisfactory floc; however, alum used with acid-treated sodium silicate did produce small-sized floc particles, and facilities for this chemical treatment scheme were adopted.

Because it was evident that some of the wells were periodically receiving gross pollution, the institution officials decided to build a 10-mile pipe line connecting with the Kankakee public water supply. This 16-inch pipe line, some of it requiring rock excavation, cost approximately $240,000. The emergency filtration plant, however, remained in operation approximately two and one-half years until the pipe line was completed.

# TYPHOID FEVER

## MANTENO STATE HOSPITAL

## NUMBER OF CASES OCCURRING DAILY SHOWING INMATES, EMPLOYEES AND OTHER CASES

## 1939

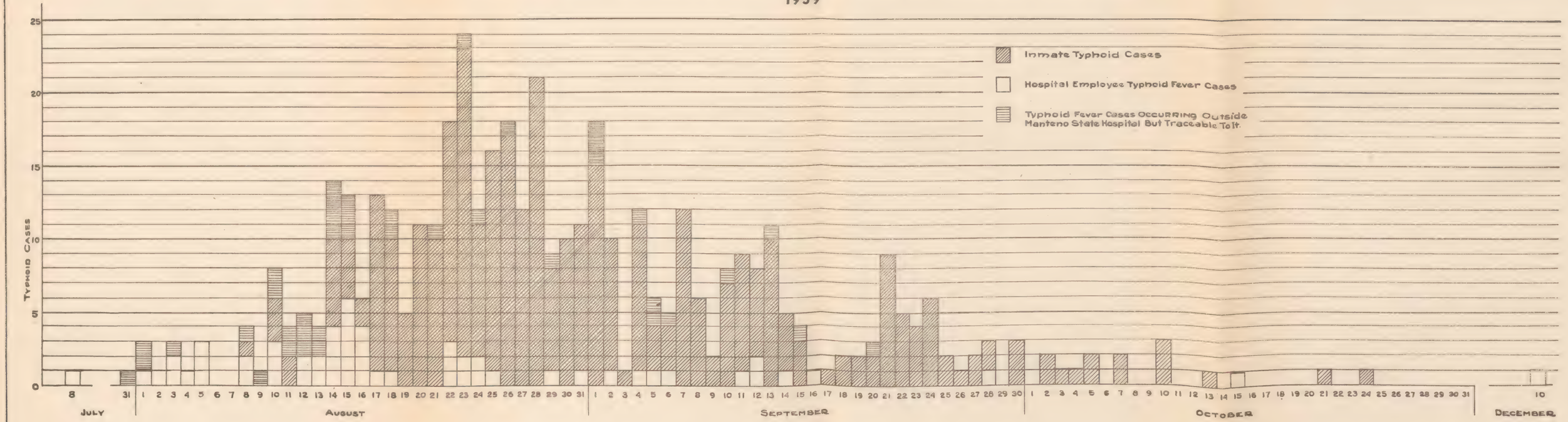



FIG. 5

CES. OME.MD.
5-21-40

## CHAPTER VII

# EPIDEMIOLOGY

As complete an epidemiological history as possible was taken of every case which was definitely diagnosed either by clinical or laboratory data as typhoid fever. This was true for cases occurring outside the institution but traceable to it, as well as for those occuring on the institution grounds. The data were collected by either a trained epidemiologist or by one of the special investigators who had had much epidemiological experience. Much difficulty was encountered in collecting these data from inmates of the institution; because of their psychotic condition, they were frequently unable to give rational answers to the questions asked. It became necessary, therefore, to supplement these histories as far as possible with information which could be gleaned from the official institution records.

ONSET OF EPIDEMIC. The records of the Illinois Department of Public Health show that only 5 cases of typhoid fever had been reported from Manteno State Hospital from the time it opened in 1930 until July, 1939. Of these 5 cases, 4 occurred during the Fall and early Winter of 1936, and the other in February, 1937. The spacing of these cases indicated the probable source and means of transmission of the causative organisms to be direct contact with either another case or a carrier.

As has been stated before, the next case of typhoid fever was reported to the Department of Public Health on July 19, 1939, the onset having been on July 8, and the patient having died on July 15. Thereafter, beginning on July 31, 1939, additional cases developed almost every day for the next two and one-half months among persons at, or who had been in, Manteno State Hospital, the last case occurring in a laboratory worker on December 10, 1939. In all, there occurred in this epidemic 453 cases of typhoid fever which could be traced directly to the institution. The distribution of the dates of onset of these cases is shown in Fig. 5. Some of the difficulties encountered in trying to place dates of onset accurately have been discussed in Chapter II.

Since much of the data concerning the onset of the disease in inmates was obviously untrustworthy, Fig. 6 was prepared in order to determine as accurately as possible the suddenness of onset of the epidemic proper. In this graph are shown data for only those typhoid fever cases occurring in persons other than inmates. This graph indicates that the peak of the epidemic was reached on August 15. Considering that the incubation period of typhoid ranges from 3 to 40 days and that the onset is usually insidious, one may consider the initial rise of this epidemic curve as being relatively acute. It is interesting to note further in this graph the fact that the curve subsides almost to the base line approximately one month following the installation of double chlorination of the drinking water. Further examination of this fact tends to indicate that the infecting dose of *E. typhosa* was either tremendous or the organisms were extremely virulent, for it will be noted that 7 out of the 10 deaths represented occurred in persons who became ill prior to the peak of the epidemic.

# TABLE VII

## MANTENO STATE HOSPITAL

### Typhoid Epidemic

### First Cases in Order of Occurrence

| Reported Order of Occurrence | Onset and Initials | | Age | Sex | Occupation | Residence | Remarks |
|---|---|---|---|---|---|---|---|
| 1 | 7–8 | J.O. | 31 | M | Inmate | Quine 2 | |
| 2 | 7–31 | H.B. | 24 | M | Constr | Kankakee | |
| 3 | 8–1 | J.B. | 26 | M | Hosp. Emp. | | Worked on Billings 2 |
| 4 | 8–1 | E.L.A. | 37 | M | Constr. | Kankakee | |
| 5 | 8–1 | E.R. | 40 | M | Constr. | Joliet | |
| 6 | 8–3 | W.G. | 13 | M | Son of Hosp. Emp. | | |
| 7 | 8–3 | F.N. | 30 | F | P. O. Clerk | | |
| 8 | 8–3 | C.McD. | 21 | M | Constr. | Palestine | |
| 9 | 8–4 | O.S. | 27 | F | Hosp. Emp. | | Worked on Female Hy. |
| 10 | 8–5 | W.H. | 41 | M | Hosp. Emp. | | Worked on H. Grounds |
| 11 | 8–5 | H.R. | 27 | M | Hosp. Emp. | | Worked on Rush 2 |
| 12 | 8–5 | E.S. | 38 | M | Hosp. Emp. | | Worked on Male Rec. |
| 13 | 8–8 | R.R. | 34 | F | Hosp. Emp. | | Worked on Female Hy. |
| 14 | 8–8 | G.S. | 20 | M | Constr. | Arlington Hts. | |
| 15 | 8–8 | W.C. | 30 | M | Hosp. Emp. | | Worked on Kilbourne |
| 16 | 8–8 | R.B. | 28 | M | Inmate | Quine 2 | |
| 17 | 8–9 | L.S. | 38 | M | Hosp. Emp. | Pana | Worked on Quine 2 |
| 18 | 8–10 | H.C. | 35 | F | Hosp. Emp. | | Worked in Morgan D.R. |
| 19 | 8–10 | M.H. | 50 | F | Hosp. Emp. | | Worked on James 2 |
| 20 | 8–10 | H.K. | 50 | F | Hosp. Emp. | | Worked in Williams D.R. |
| 21 | 8–10 | A.J. | 36 | F | Inmate | Diag. Int. Th. | |
| 22 | 8–10 | M.L. | 27 | F | Inmate | Dix | |
| 23 | 8–10 | A.M. | 70 | F | Inmate | Hospital 2 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 24 | 8–10 | H.R. | 53 | M | Hosp. Emp. | | Sewage Plant Operator |
| 25 | 8–10 | F.W. | 28 | M | Dynamiter | Ottawa | In M.S.H. Only 3 Days and Only Drank Water—Ate No Food |
| 26 | 8–11 | E.M. | 47 | F | Inmate | Diag. Int. Th. | |
| 27 | 8–11 | A.H. | 62 | F | Inmate | Diag. Int. Th. | Prior to 7–29 Had Been in Adler 1 |
| 28 | 8–11 | N.H. | 21 | F | Hosp. Emp. | | |
| 29 | 8–11 | A.W. | 8 | M | Student | Visitor | |
| 30 | 8–12 | C.C. | 45 | F | Hosp. Emp. | | Worked on Hannah |
| 31 | 8–12 | P.S. | 26 | M | Hosp. Emp. | | Worked on Diag. Int. Th. |
| 32 | 8–12 | G.S. | 30 | M | Truck Dr. | Streator | Made Daily Trips to M.S.H. but Drank Only Water There |
| 33 | 8–12 | W.M. | — | M | Constr. | Chicago (?) | Worked in M.S.H. from 7-24 |
| 34 | 8–12 | G.Y. | 30 | M | Truck Dr. | Streator | Made Daily Trips to M.S.H. Drank Water. |
| 35 | 8–13 | K.B. | 25 | F | Hosp. Emp. | | Worked in Officers' D.R. |
| 36 | 8–13 | R.P. | 28 | M | Hosp. Emp. | | Worked on Diag. Male Int. Th. |
| 37 | 8–13 | H.G. | 25 | M | Hosp. Emp. | | |
| 38 | 8–13 | L.K. | 40 | M | Hosp. Emp. | | Worked on Quine 2 |
| 39 | 8–14 | B.L. | 42 | F | Hosp. Emp. | | Worked on Hosp. 2 |
| 40 | 8–14 | J.B. | 32 | M | Hosp. Emp. | | Drove Food Truck |
| 41 | 8–14 | J.D. | 28 | M | Constr. | | Worked Constr. Emp. Bldg. All July and Aug. |
| 42 | 8–14 | L.P. | 37 | M | Constr. | | |
| 43 | 8–14 | E.B. | 62 | F | Inmate | Mitchell 2 | |
| 44 | 8–14 | M.D. | 39 | F | Inmate | Diag. Int. Th. | |
| 45 | 8–14 | M.P. | 68 | F | Inmate | Kraeplin 2 | |
| 46 | 8–14 | C.P. | 39 | F | Inmate | Adler 2 | |
| 47 | 8–14 | D.R. | 68 | F | Inmate | Diag. Female Rec. | |
| 48 | 8–14 | H.B. | 38 | M | Inmate | Meyer 2 | |
| 49 | 8–14 | T.R. | 25 | M | Constr. | Kankakee | |
| 50 | 8–14 | E.H. | 35 | M | Constr. | Bradley | |
| 51 | 8–14 | F.F. | 18 | M | Constr. | Joliet | |
| 52 | 8 14 | S.S. | 49 | F | Visitor | Lovington | Visited M.S.H. July 20. Ate Ice Cream and Drank Water |

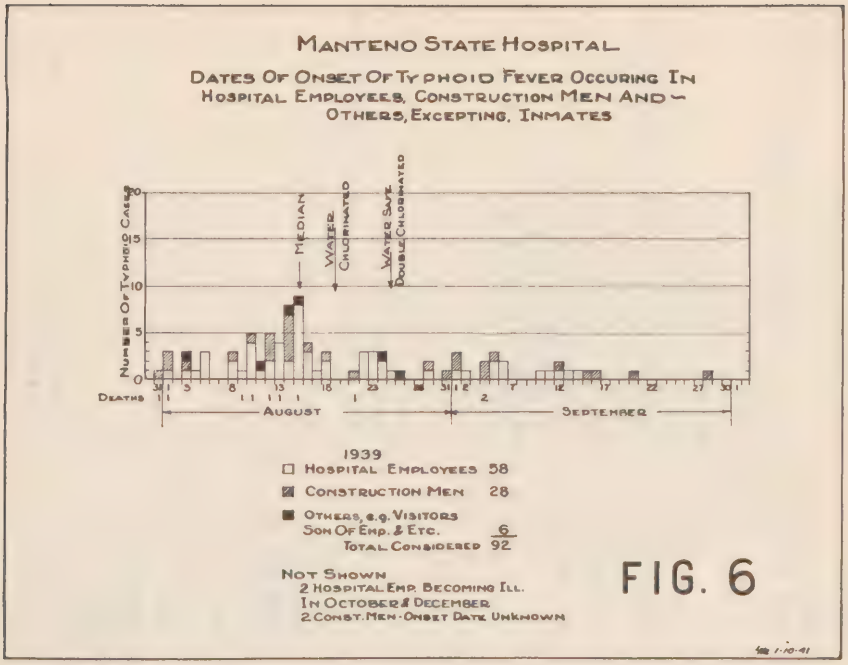



FIG. 6

Table VII lists chronologically those typhoid cases which occurred prior to the assumed peak of the epidemic on August 15. Here it will be noted that among these first 52 cases, there were 22 hospital employees, 14 construction workers, 13 inmates, 2 visitors, and a son of an attendant. Of the 14 construction workers, there were none who lived on the institution grounds; and furthermore, investigation of these cases disclosed that many had eaten no food nor come in contact with any patients in the institution. Two of these persons made daily trips driving a brick-truck, between Streator and Manteno State Hospital. These men both stated that they had never eaten any food at the institution, but since the weather was particularly warm and dry, they drank large quantities of water during their brief stays at the institution. Another of these men, from Ottawa, Illinois, was in the institution only on 3 separate days and drank water while there. The exact dates of this man's visits could not be obtained; but it is known, however, that they were during the latter part of July or approximately 3 weeks prior to the onset of his illness. There was no other known exposure to typhoid fever in this case.

One of the two visitors was in Manteno State Hospital only on July 20, 1939, and she stated that while there she ate ice cream at the institution commissary and also consumed water from the institution supply. She was unable to recall having partaken any other food or drink during her visit. There were no other cases of typhoid fever in her home town during the summer of 1939.

Of the first 52 cases, there were 4 employees who handled food. These people worked respectively in Morgan Dining Room, Williams Dining

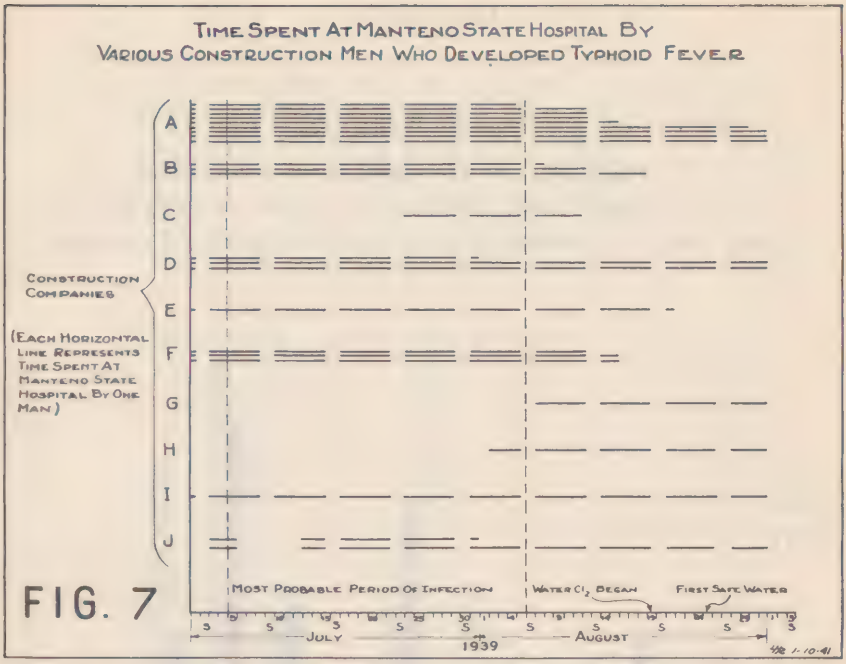



FIG. 7

Room, the Officers' Dining Room, and on a food truck. On August 15 and 16, two of the cooks in the central kitchen were reported as having typhoid fever. Since it has been adequately shown by previous investigations that persons in the incubationary stage of typhoid fever are infectious, these latter individuals may have been responsible for some of the cases occurring later in August or early September.

That secondary cases occurred among contacts with the first cases is undoubted, inasmuch as some of the early inmate cases came from extremely untidy wards where there existed unlimited possibilities for patients to come in contact with the body discharges of their fellow patients.

PERIOD OF INFECTION. If the probable incubation period of typhoid fever is taken as 10 to 40 days, then, counting backward this number of days from the assumed peak of the epidemic on August 15, we find that the probable period of infection would be between July 5 and August 5.

The records of the various construction companies pertaining to those workmen who developed typhoid fever were examined to determine as closely as possible the period of employment of these men at Manteno State Hospital. The results of this investigation are shown graphically in Fig. 7, where it will be noted that most of the construction workers who developed typhoid fever were working at the hospital during the computed probable period of infection; namely, between July 5 and August 5.

INCIDENCE. Due to the fact that persons of all classifications working in different parts of the institution grounds developed typhoid fever, it appeared that there was some common factor operable universally through-

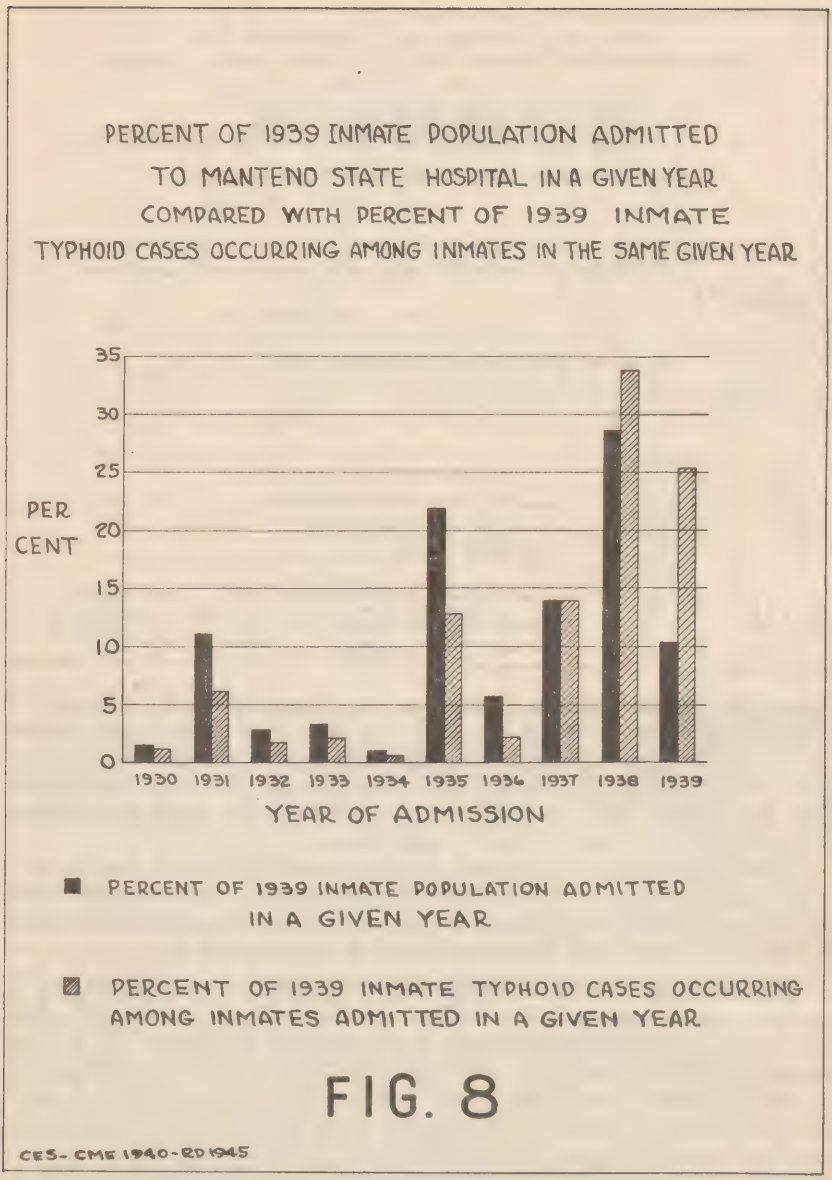



FIG. 8

out the institution which served as a means of transmission for the typhoid infection. Therefore, in searching for an explanation of the additional fact that relatively few persons developed typhoid fever in comparison to the large number who may have been exposed to infection, the incidence was computed for inmates according to the year of admission to the institution. This study is shown in Table VIII and Fig. 8, from which it is

## TABLE VIII

COMPOSITION OF 1939 INMATE POPULATION SHOWING YEAR OF ADMISSION IN RELATION TO INCIDENCE OF TYPHOID FEVER

| Year of Admission | No. of Inmates | % of 1939 Inmate Population | Inmate Typhoid Cases | % of Inmate Typhoid Cases |
|---|---|---|---|---|
| 1930 | 66 | 1.38 | 4 | 1.12 |
| 1931 | 528 | 11.07 | 22 | 6.16 |
| 1932 | 123 | 2.58 | 6 | 1.68 |
| 1933 | 159 | 3.33 | 7 | 1.96 |
| 1934 | 50 | 1.05 | 2 | .56 |
| 1935 | 1,040 | 21.80 | 46 | 12.89 |
| 1936 | 275 | 5.76 | 8 | 2.24 |
| 1937 | 667 | 13.98 | 50 | 14.01 |
| 1938 | 1,366 | 28.63 | 121 | 33.89 |
| 1939 | 497 | 10.42 | 91 | 25.49 |
| Total | 4,771 | 100.00 | 357 | 100.00 |

apparent that typhoid fever struck most heavily among those who had entered the hospital in the 2 years preceding the epidemic. Application of the Chi-square test of probability to these data, as shown in Table IX, indicates that the difference in attack rates was highly significant and would not have occurred as often as once in a hundred times due to pure chance alone. Therefore, it appears that, in the absence of typhoid vaccination, some common factor may have been in operation over a period of years in transmitting small doses of typhoid organisms throughout Manteno State Hospital and thereby increasing the immunity of those who had resided there for more than 2 years.

Geographically, the incidence of typhoid cases among inmates of the various cottages varied widely from 21.5 to 1.2 per hundred inmates. The specific rates for inmates residing in each of the cottages is shown in Table X. It is noteworthy that all of the wards with the highest incidence; namely, Dix, Diagnostic Female and Male, Williams, Kraepelin, Myer, Wines, and White, were those to which newly admitted inmates were routinely sent. Therefore, in the light of the preceding study, the high incidence in these particular cottages can be explained by the fact that the population of these cottages, for the most part, represented those inmates who had resided in Manteno State Hospital for the shortest time and had little opportunity to acquire herd immunity to typhoid.

The incidence by place of residence for other than inmates could not be determined since the population of the various employees' dormitories was constantly changing and many of the persons in this classification lived off the institution grounds.

## TABLE IX

CHI-SQUARE TEST OF SIGNIFICANCE OF OBSERVED RELATION BETWEEN INMATE TYPHOID INCIDENCE AND YEAR OF ADMISSION TO INSTITUTION

| Adm. Year | $(O_1)$ Typhoid Cases | $(O_2)$ No. Typhoid | Total Pop. 1939 | $(T_1)$ | $(T_2)$ | $O_1-T_1$ | $O_2-T_2$ | $(O_1-T_1)^2$ | $(O_2-T_2)^2$ | $\frac{(O_1-T_1)^2}{T_1}$ | $\frac{(C_1-T_1)^2}{T_1}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1930..... | 4 | 62 | 66 | 4.02 | 69.91 | −0.92 | 1.09 | .8464 | 1.1664 | .172 | .019 |
| 1931..... | 22 | 506 | 528 | 39.52 | 488.63 | −17.52 | 17.37 | 306.9504 | 301.7169 | 7.767 | .016 |
| 1932..... | 6 | 117 | 123 | 9.21 | 113.88 | −3.21 | 3.12 | 10.3041 | 9.7344 | 1.119 | .085 |
| 1933..... | 7 | 152 | 159 | 11.89 | 146.98 | −4.89 | 5.02 | 23.9121 | 25.2004 | 2.011 | .171 |
| 1934..... | 2 | 48 | 50 | 3.75 | 46.35 | −1.75 | 1.65 | 3.0625 | 2.7225 | .817 | .059 |
| 1935..... | 46 | 994 | 1,040 | 77.83 | 962.25 | −31.83 | 31.75 | 1,013.1489 | 1,008.0625 | 13.017 | 1.048 |
| 1936..... | 8 | 267 | 275 | 20.56 | 254.25 | −12.56 | 12.75 | 157.7536 | 162.5625 | 7.673 | .620 |
| 1937..... | 50 | 617 | 667 | 49.91 | 617.08 | −0.09 | 0.08 | .0081 | .0064 | .000 | .000 |
| 1938..... | 121 | 1,245 | 1,366 | 102.21 | 1,263.73 | −18.79 | 18.73 | 353.0641 | 350.8129 | 3.454 | .278 |
| 1939..... | 91 | 406 | 497 | 37.20 | 459.94 | −53.80 | 53.94 | 2,894.4400 | 2,909.5236 | 77.808 | 6.326 |
| Total..... | 357 | 4,414 | 4,771 | 357.00 | 4,414.00 | 0.00 | 0.00 | | | 113.838 | 8.622 |

$X^2 = 113.838 + 8.622 = 122.460$

## TABLE X

### Incidence of Typhoid Cases by Wards

| Cottage | Typhoid Incidence Per 100 | Cottage | Typhoid Incidence Per 100 |
|---|---|---|---|
| Dix | 21.5 | Dunne | 5.6 |
| Diagnostic Female | 18.1 | Todd | 5.4 |
| Williams | 15.5 | Willis | 5.4 |
| Kraepelin | 15.0 | Pinel | 4.2 |
| Meyer | 10.2 | T. B. Sanatorium | 4.0 |
| Wines | 10.2 | Billings | 3.7 |
| White | 9.6 | Hunter | 3.7 |
| Diagnostic Male | 9.5 | Industrial | 3.6 |
| Adler | 9.0 | Quine | 3.2 |
| James | 8.6 | Rush | 3.2 |
| Cullen | 7.8 | Morgan | 3.1 |
| Prince | 7.8 | Hannah | 2.8 |
| Barton | 7.7 | McDowell | 1.8 |
| Adams | 7.5 | Goodner | 1.7 |
| Dewey | 6.2 | Mitchell | 1.3 |
| Kilbourne | 5.9 | Hospital | 1.2 |

The incidence by age and sex for inmates is given in Table XI. Here it will be noted that relatively more cases developed among those in the younger age groups, and that the total incidence for females was 7.3 per hundred population as compared to 5.0 for males. These latter rates by sex represent a reversal of the usually expected greater typhoid incidence among males, and therefore should be explained. Referring to Table XII, it will be noted that 60% of the 1939 female inmate population had been in residence at Manteno State Hospital for less than 2 years, as compared to only 45% of the male population. Thus, if the previously stated hypothesis regarding the development of typhoid immunity as a concurrent event to years of residence in the hospital is warranted, it may be assumed that approximately one-third again as many female inmates were susceptible to typhoid fever in 1939 as there were males. This assumption is a possible explanation for the reversal of the expected incidence by sex.

Table XIII shows the incidence by age and sex for employees of the institution and also for the construction men who were employed on the grounds. Female employees had a typhoid incidence of 7.3 per hundred compared to 8.4 for males. The total employee incidence of 7.8 did not differ significantly from that for inmates; i. e., 6.2 per hundred. The rate of 5.4 typhoid cases per hundred construction men is only a rough estimate, since the total number of men exposed could not be accurately determined.

CARRIER-DETECTION PROCEDURES. The classification of the 453 typhoid fever cases in the Manteno State Hospital epidemic ac-

## TABLE XI

### Typhoid Cases and Incidence Among Inmates by Age and Sex

| Age | Female Inmates | | | Male Inmates | | | Total Inmates | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total Pop. | Typhoid Cases | % Typhoid | Total Pop. | Typhoid Cases | % Typhoid | Total Pop. | Typhoid Cases | % Typhoid |
| 10–14... | 1 | 0 | 0.0 | 0 | 0 | 0.0 | 1 | 0 | 0.0 |
| 15–19... | 20 | 3 | 15.0 | 26 | 3 | 11.5 | 46 | 6 | 13.1 |
| 20–24... | 62 | 6 | 9.7 | 76 | 7 | 9.2 | 138 | 13 | 9.4 |
| 25–29... | 149 | 12 | 8.0 | 174 | 12 | 6.9 | 323 | 24 | 7.4 |
| 30–34... | 234 | 22 | 9.4 | 322 | 23 | 7.1 | 556 | 45 | 8.1 |
| 35–39... | 335 | 36 | 10.8 | 395 | 33 | 8.4 | 730 | 69 | 9.4 |
| 40–44... | 360 | 35 | 9.7 | 276 | 11 | 4.0 | 636 | 46 | 7.2 |
| 45–49... | 407 | 30 | 7.4 | 333 | 16 | 4.8 | 740 | 46 | 6.2 |
| 50–54... | 324 | 21 | 6.5 | 374 | 11 | 2.9 | 698 | 32 | 4.6 |
| 55–59... | 302 | 23 | 7.6 | 317 | 10 | 3.2 | 619 | 33 | 5.3 |
| 60–64... | 249 | 7 | 2.8 | 225 | 10 | 4.4 | 474 | 17 | 3.6 |
| 65–69... | 174 | 7 | 4.0 | 159 | 5 | 3.1 | 333 | 12 | 3.6 |
| 70–74... | 104 | 7 | 6.7 | 129 | 2 | 1.6 | 233 | 9 | 3.9 |
| 75–79... | 90 | 2 | 2.2 | 84 | 1 | 1.2 | 174 | 3 | 1.7 |
| 80–84... | 41 | 0 | 0.0 | 19 | 2 | 11.5 | 60 | 2 | 3.3 |
| Over 85. | 22 | 0 | 0.0 | 11 | 0 | 0.0 | 33 | 0 | 0.0 |
| Total... | 2,874 | 211 | 7.3 | 2,920 | 146 | 5.0 | 5,794 | 357 | 6.2 |

## TABLE XII

### 1939 Inmate Population According to Sex and Time Spent in Institution

| Years Residence | Females | | Males | | Total |
|---|---|---|---|---|---|
| More than 2..... | 944 | 39.42% | 1,297 | 54.59% | 2,241 |
| Less than 2..... | 1,451 | 60.58% | 1,079 | 45.41% | 2,530 |
| Total..... | 2,395 | 100.00% | 2,376 | 100.00% | 4,771 |

cording to sex, occupation, place of hospitalization, and ultimate termination is shown in Tables XIV and XV. It should be noted that only 411 typhoid patients were hospitalized at Manteno State Hospital; therefore, this study on the discovery of carriers is confined to this group and the 6,100 contacts living at the hospitals.

The rules and regulations for the control of communicable diseases in the State of Illinois[1] required in 1939 that all contacts with a case of typhoid fever submit 2 specimens of feces and urine (each collected from the second or third bowel movement following a cholagogue cathartic) taken at least 24 hours apart, for examination for the presence of typhoid organisms. Since all of the 6,100 inmates and employees of Manteno had been in contact with typhoid cases, it was necessary to have feces and urine specimens from each of them examined according to the State Department of Public Health rules. For additional safety, all food handlers within the institution were required to submit at least 1 additional specimen.

The 700 institutional employees were instructed as to the requirements and allowed to collect their specimens of feces and urine without supervision. However, 2 details of nurses and attendants were delegated for the collection of specimens from inmates. One of these details, consisting of 2 attendants, systematically collected specimens in all male cottages, whereas the other, consisting of a registered nurse, visited all the female cottages for the same purpose. By this means the identification and proper collection of specimens from all inmates was facilitated.

From one-half to one ounce of magnesium sulphate was given to the patients in the morning, and the second or third resulting bowel movement was deposited in a sterile bedpan or commode chamber, from which a very small particle of feces and about 1 dram of urine were taken and placed in a sterile specimen bottle for delivery to the laboratory. No preservative was added to the specimen, since it usually arrived at the laboratory from 1 to 12 hours after collection.

Through these methods specimens were collected from 4,900 inmates and approximately 600 employees, the remainder of the total of 6,100 persons either having developed typhoid or having fled in panic from the institution and the epidemic. In the entire group of approximately 5,500 employees and inmates, positive specimens were reported in the cases of 29 females and 26 males, or a total of 55 persons. Of these, only 6 had a definite history of previously having had typhoid fever.

Among the 53 inmates represented, 4 showed the presence of *S. paratyphi B* organisms in the specimens submitted. Two of the 4 never again had a positive specimen out of the several submitted at weekly intervals over a period of 6 months. One of the *S. paratyphi B* cultures was isolated from an 8-month-old girl, whose blood serum failed to agglutinate the organisms isolated from the stool. Consideration of this finding, together with the fact that 7 feces specimens were reported as negative over a period of 2 months, finally eliminated this patient from the carrier classification. The remaining inmate, found to have *S. paratyphi B* organisms in her stool specimen, in time was found to be a carrier of *E. typhosa,* also. These persons were all isolated in a separate cottage and subjected to further study of fecal and urine specimens.

[1] *State of Illinois: Manual and Outline of Procedure for Health Officers for the Control of Communicable Diseases.* 1935. P. 125.

## TABLE XIII

### Typhoid Cases Among Non-inmates by Age and Sex

| Age | Hospital Employees | | | Construction Men | Others | Total |
|---|---|---|---|---|---|---|
| | Females | Males | Total | | | |
| 5– 9.... | 0 | 0 | 0 | 0 | 3 | 3 |
| 10–14.... | 0 | 0 | 0 | 0 | 1 | 1 |
| 15–19.... | 0 | 0 | 0 | 1 | 0 | 1 |
| 20–24.... | 5 | 3 | 8 | 5 | 1 | 14 |
| 25–29.... | 6 | 7 | 13 | 6 | 0 | 19 |
| 30–34.... | 4 | 8 | 12 | 2 | 0 | 14 |
| 35–39.... | 4 | 6 | 10 | 8 | 0 | 18 |
| 40–44.... | 3 | 4 | 7 | 2 | 0 | 9 |
| 45–49.... | 2 | 1 | 3 | 2 | 1 | 6 |
| 50–54.... | 2 | 2 | 4 | 0 | 0 | 4 |
| 55–59.... | 2 | 0 | 2 | 0 | 0 | 2 |
| 60–64.... | 0 | 0 | 0 | 1 | 0 | 1 |
| 65–69.... | 0 | 0 | 0 | 0 | 0 | 0 |
| 70–74.... | 1 | 0 | 0 | 0 | 0 | 1 |
| Unknown. | 0 | 0 | 0 | 3 | 0 | 3 |
| Total.. | 29 | 31 | 60 | 30 | 6 | 96 |
| Population | 396 | 370 | 768 | 555 | – | – |
| % Typhoid.. | 7.3 | 8.4 | 7.8 | 5.4 | – | – |

Of the 2 employees found to have positive specimens, 1 was reported at first as harboring only paratyphoid B organisms, but later was found to be a typhoid carrier. Both these persons were placed under a typhoid-carrier agreement.

Of the 55 carriers found on survey of the contacts, 9 were employed in food-handling capacities. However, only 3 of these were employed in the central kitchen, the remaining 6 working in ward kitchens where they could only possibly contribute to the spread of typhoid in their respective wards. In the central kitchen there were 6 different menus prepared; namely, officers' dining room menu, employees' dining room menu, industrial menu, regular menu, infirm-patients' menu, and special hospital diets. It is improbable that the 3 carriers working in the central kitchen came in contact with all the 6 different menus served to the entire institutional population, yet there was no cottage in the institution which was spared of typhoid fever.

For release from the quarantine for typhoid fever, the Illinois rules and regulations[2] required in 1939 that the patient submit 2 successive neg-

## TABLE XIV

### Typhoid Patients Hospitalized at Manteno

| Case Termination | Inmates | | Hospital Employees | | Constr. Men | Others | | Total |
|---|---|---|---|---|---|---|---|---|
| | M | F | M | F | | M | F | |
| Released | 112 | 136 | 22 | 17 | 7 | 1 | 0 | 295 |
| Chronic Carriers | 14 | 44 | 0 | 4 | 0 | 0 | 0 | 62 |
| Died Typhoid | 18 | 30 | 2 | 0 | 1 | 0 | 0 | 51 |
| Died Other Causes | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 3 |
| Total | 146 | 211 | 24 | 21 | 8 | 1 | 0 | 411 |

## TABLE XV

### Typhoid Patients Hospitalized Outside Manteno

| Case Termination | Hospital Employees | | Construction Men | Others | | Total |
|---|---|---|---|---|---|---|
| | Male | Female | | M | F | |
| Released | 4 | 7 | 15 | 3 | 1 | 30 |
| Chronic Carriers | 1 | 1 | 0 | 0 | 1 | 3 |
| Died Typhoid | 2 | 0 | 7 | 0 | 0 | 9 |
| Total | 7 | 8 | 22 | 3 | 2 | 42 |

## TABLE XVI

### Chronic Typhoid Carriers and Chronic-Carrier Rates Discovered by Examination of Initial Survey and Release Specimens

| | Persons Examined | Carriers Found | Carrier Rate |
|---|---|---|---|
| Survey Specimens | 5,500* | 55 | 1.00% |
| Release Specimens | 411 | 45 | 10.95% |
| Total | 5,911 | 100 | .... |

*Approximate number.

ative specimens of feces and urine, the first being taken 10 days after the temperature became normal, and the second 1 week after the first. A third specimen was required from the majority of the 411 Manteno patients before release was granted, and this additional specimen was taken 1 week after the second. No cathartic could be given before collecting these release specimens due to the friable condition of the small bowel.

The release specimens were all collected in the typhoid wards under the supervision of trained public-health nurses. The specimen was deposited in a sterile bedpan or commode chamber under the observation of the nurse, who then transferred a sample of the fecal mass and a sample of the urine to a sterile specimen bottle, using an uncontaminated wooden tongue blade and a sterilized spoon. In most instances these specimens received no preservative and were delivered to the laboratory within 6 hours after collection.

In some cases as many as 7 release specimens were submitted, and out of the entire group of 411 typhoid cases at least 1 of the release specimens from each of 87 patients showed the presence of *E. typhosa*. These persons were classified as convalescent carriers, and represented a convalescent carrier rate of 21.2%. Forty-two of these persons, however, managed to submit at least 3 successive negative specimens subsequently at weekly intervals before 3 months from the time of onset. This left 45, who, according to the rules and regulations, were classified as chronic carriers, giving a chronic carrier rate of 10.95 per hundred cases. These carriers were isolated in the same cottage as the carriers found among the contacts and were subjected to further study of their fecal and urine specimens. Three of the forty-five were employees, two of who were released under typhoid-carrier agreement, but the third suffered a typhoid psychosis and was placed in isolation with the inmate carriers.

Table XVI summarizes the results of both the carrier survey among contacts, and release specimens.

All laboratory work was conducted either in the emergency laboratory maintained at the hospital during the period of August through December, 1939, or in the Chicago or Springfield laboratories of the Illinois Department of Public Health. The total number of specimens and the results from each place are recorded in Table XVII. With the completion of the original survey among contacts for carriers, most of the work was done in the Chicago laboratory. This fact accounts for the seemingly disproportionate number of positive specimens discovered in this laboratory as shown in the table, for most of the specimens examined there were from known carriers.

The standard procedure followed in making these bacteriological analyses was to plate the specimen on either Wilson-Blair bismuth sulphite brilliant green agar or desoxycholate-citrate agar, or both (in Chicago and Springfield both were used at times, but in the emergency laboratory the Wilson-Blair medium alone was used almost exclusively). Suspicious colonies were then picked from the differential media and inoculated into at least 7 carbohydrate sugar broths where the characteristic reactions of intestinal pathogens were sought. Indole tests, hydrogen sulphide production, mo-

[2] *State of Illinois: Manual and Outline of Procedure for Health Officers for the Control of Communicable Diseases.* 1935. P. 124.

## TABLE XVII

### Total Bacteriological Analyses of Fecal and Urine Specimens and Positive Results Reported from State Laboratories from August, 1939, through June, 1941

| Laboratory | Total Specimens Examined | Total Specimens Positive |
|---|---|---|
| Emergency (Manteno) | 13,974 | 330 |
| Chicago | 12,837 | 2,031 |
| Springfield | 246 | 6 |
| Total | 27,057 | 2,367 |

tility, and Gram-staining characteristics were also recorded. Agglutination tests were used to confirm all cultures showing positive results in these tests. All interpretations of these findings were made by bacteriologists thoroughly experienced in enteric-disease work.

Specimens shipped to the Chicago or Springfield laboratories were protected against overgrowth of the ordinary fecal bacterial flora by a sterile buffered 30% glycerine solution. The time interval between collection and plating of the shipped specimens was in most instances not over 48 hours and usually much less.

TYPHOID-CARRIER INCIDENCE. As was mentioned above, positive stool and urine specimens were found in the case of 55 persons, who at no time during the epidemic had any subjective or objective signs of typhoid fever. These individuals were classified as contact carriers, and represented a carrier rate of approximately 1 per 100 total population. Klinger, in 1906, isolated *E. typhosa* from the excreta of 15 cases out of a total of 1,700 examined in an area in which typhoid fever was epidemic.[3] This is a carrier rate of 0.85%. Gill[4] found a carrier rate of 5.1% in 1,076 milk handlers in an endemic area in Alabama.

Among the 411 cases of typhoid fever, 87, or 21.2%, continued as fecal carriers after their temperatures reached normal. Only 45, or 10.95% of the total, however, continued persistently to excrete typhoid organisms in the feces and urine at the end of 3 months from the time of onset of illness, thereby automatically becoming chronic convalescent carriers. These figures may be constrasted with those of Garbat[5], who found 32% of 164 cases of typhoid continuing as fecal carriers after subsidence of the symptoms. In his series of cases, which were studied over a period of 4 months or longer, as were those in our series, only 3 or 4% became chronic carriers. The chief difference observed between these two studies is that about three

[3] Klinger, P.: Arb. Reichsgesundh. Ant. 25; 223, 1906.
[4] Gill, D. G.: J. A. M. A., 89; 1198, 1927.
[5] Garbat, A. L.: Rockefeller Inst. for Med. Research, Monograph #16, 5-10-22.

times as many chronic carriers persisted in the Manteno epidemic as in that reported by Garbat.

The figures taken more or less as standard today for carrier rates among convalescing typhoid patients, are 2 to 5% as reported by Bigelow and Anderson[6] and Park[7]. It must be recognized, however, that these former carrier studies were made prior to the time that greatly improved isolation media such as Wilson and Blair's bismuth sulphite agar and Leifson's desoxycholate-citrate agar came into general use as differential media in typhoid-culture work. It has been shown by Mayfield and Gober[8], among others, that the use of these 2 media vastly facilitates the isolation of *E. typhosa* from fecal specimens.

The age distribution of the contact carriers and the convalescent carriers was found to be not significantly different from that of the institution population and the typhoid cases, respectively. These distributions are shown in Table XVIII.

Table XIX lists the sex distribution of the typhoid carriers. It should be noted that approximately one-third of the total were males, an observation that tallies very closely with the sex distribution of typhoid carriers in New York State as reported by Senftner and Coughlin[9], who found 120 males out of a total of 368 carriers. Gowen[10], in a similar study for the State of Illinois, found a higher percentage of males; namely, 46 out of 110 carriers. It is interesting to note further, in Table XIX, that the sex distribution of contact carriers is in proportion to that of the institutional population, whereas among the chronic carriers the proportion of males to typhoid cases is significantly lower.

Three additional cases of typhoid fever occurred at Manteno State Hospital during the latter part of March, 1940, at least 2 months after the last patient of the epidemic had been released. At this time the water supply was of a safe and sanitary quality, and had been so for at least 1 month. No suspicion was attached to the milk supply, all foodstuffs were being obtained from reliable wholesalers, and all food handlers had had 3 to 5 fecal and urine cultures found negative for typhoid. As a result, there was a strong suspicion that these 3 new cases had obtained their infection through direct contact with an undiscovered typhoid carrier. All 3 of the typhoid cases had had negative fecal and urine cultures at the time of the initial survey.

Following the administration of magnesium sulphate two fecal and urine specimens were examined from all contacts with the recent typhoid cases and also from all persons who had been released by the usual procedure after having had typhoid fever during the epidemic. This new survey, conducted in April, 1940, resulted in the discovery of 17 new typhoid carriers, only 3 of whom had been in contact with the recent cases. Thirteen of these carriers had had typhoid fever during the recent epidemic, and only 3 of the 13 had shown a positive result during the examination of their release specimens in 1939.

[6] Bigelow, G. H., and Anderson, G. W.: J. A. M. A. **101**; 348, 1933.
[7] Park, W. H.: J. A. M. A. **51**; 981, 1908.
[8] Mayfield, C. R., and Gober, M.: Am. J. Pub. Health, **30**; 69, 1940.
[9] Senftner, H. F., and Coughlin, F. E.: Am. J. Hyg. **17**; 711, 1933.
[10] Gowen, G. Howard: Ill. Med. J. **73**; 38, 1938.

## TABLE XVIII

### Age Distribution of Population, Contact Carriers, Typhoid Cases, and Chronic Carriers Among Inmates

1939

| Age | Inmate Population | Inmate Contact Carriers | Inmate Typhoid Cases | Inmate Chronic Carriers |
|---|---|---|---|---|
| 10–14 | 1 | 0 | 0 | 0 |
| 15–19 | 46 | 0 | 6 | 0 |
| 20–24 | 138 | 1 | 13 | 0 |
| 25–29 | 323 | 6 | 24 | 2 |
| 30–34 | 556 | 6 | 45 | 6 |
| 35–39 | 730 | 4 | 69 | 4 |
| 40–44 | 636 | 6 | 46 | 7 |
| 45–49 | 740 | 4 | 46 | 7 |
| 50–54 | 698 | 9 | 32 | 7 |
| 55–59 | 619 | 7 | 33 | 7 |
| 60–64 | 474 | 2 | 17 | 0 |
| 65–69 | 333 | 4 | 12 | 1 |
| 70–74 | 233 | 2 | 9 | 1 |
| 75–79 | 174 | 1 | 3 | 0 |
| 80–84 | 60 | 0 | 2 | 0 |
| Over 80 | 33 | 0 | 0 | 0 |
| Total | 5,794 | 52* | 357 | 42 |
| Mean age | 48.84 | 47.50 | 44.11 | 46.19 |

*Case of eight-month infant omitted.

## TABLE XIX

### Sex Distribution of Typhoid Carriers (Inmates and Employees)

1939

| Sex | Contact Carriers | Total Population | Chronic Carriers | Typhoid Cases | Total Carriers |
|---|---|---|---|---|---|
| Male | 26 | 3,290 | 8 | 179 | 34 |
| Female | 29 | 3,272 | 37 | 232 | 66 |
| Total | 55 | 6,562 | 45 | 411 | 100 |

This survey was then extended, and monthly post cathartic fecal and urine specimens were cultured from all inmates who had had typhoid fever in the 1939 epidemic and had been released upon the obtaining of 3 or more successively negative specimens. From April, 1940, to April, 1941, four additional chronic carriers were discovered among these released patients, bringing the total of additional carriers to 17. These 17 carriers, added to the original 45, produced a total of 62 chronic typhoid carriers out of 411 cases, or a carrier rate of 15 per hundred. This is the highest chronic convalescent-carrier rate ever reported.

The finding of typhoid carriers among former typhoid patients several months to a year or more after occurrence of the disease is not unusual. Leach, Dehler, and Havens[11] found 10.3% to be carriers out of 156 individuals who had recovered from typhoid fever within 6 months to 2 years previously. Gill[12] reported 9.48% carriers among a similar sample of 348 persons. Reports of other similar findings are described by Topley and Wilson[13].

From these observations it appeared that the quarantine rules allowing release of typhoid cases on only 2 specimens during the period of convalescense was too lax, for if only 2 specimens had been required for release of patients in this epidemic there would have been discovered only 20 carriers, or the usual 5%. In other words, 42 of the 62 chronic carriers found satisfied the release requirements of only 2 negative specimens during convalescence and were not discovered until further specimens were examined, the period covered being more than a year after the subsidence of the epidemic.

These observations also indicate that specimens taken following a chologogue cathartic are probably more likely to yield positive cultures than noncathartic specimens. As indicated elsewhere in this report, post cathartic specimens could not be collected safely from those who had just recovered from the disease. The Department of Public Health rules for release of cases have now been modified to require post cathartic specimens from typhoid convalescents after the danger of causing damage to weakened bowel tissue has passed.

BACTERIOPHAGE TYPING OF CULTURES. During the epidemic all of the laboratory facilities available were concentrated on the huge task of examining more than 27,000 feces and urine specimens and nearly a thousand blood specimens. It was therefore impossible to classify the cultures isolated by the then newly discovered procedure of bacteriophage (or phage) typing. Cultures were preserved and at a later date these, as well as cultures recently isolated from carriers, were tested for phage susceptibility. Unfortunately, many of the strains isolated during the outbreak had become resistant and non typable. A sufficient number could be typed, however, to indicate that the cultures were of many phage types. Furthermore, the cultures isolated from different individuals in a given cottage were of different types.

These findings indicate that there was no single original source, such as one case or carrier, for the epidemic. Instead, a situation must have oc-

[11] Leach, C. N., Dehler, S. A., and Havens, L. C.: Am. J. Pub. Health **16**; 391, 1926.
[12] Gill, D. G.: Op. cit.
[13] Topley, W. W. C., and Wilson, G. S.: Principles of Bacteriology and Immunity, Baltimore, Williams and Wilkins, P. 1219, 1938.

curred in which typhoid bacilli contributed by several different cases or carriers, each shedding typhoid organisms of a different phage type, were distributed throughout the institution. It would appear that the most plausible theory which would account for these facts is that the outbreak was water-borne and that human excreta carrying typhoid bacilli from many individuals, and thus of many phage types, had contaminated the water. Drinking water heavily contaminated with fresh sewage (including feces of typhoid carriers or cases) would, of course, cause the observed distribution of nonidentical typhoid strains.

## CHAPTER VIII

## DISCUSSION

From the foregoing data, and from all that is known scientifically of the natural history of typhoid fever, it is possible to arrive at reasonably accurate public-health conclusions as to the means of transmission of the typhoid organisms involved in the institutional epidemic described. It is well to bear in mind, however, that, as presented during the litigation and admitted in evidence by the Illinois State Supreme Court, such findings and conclusions did not constitute legal proof as to the means of transmission.

It is generally accepted as a scientific fact that most typhoid fever epidemics owe their spread either (1) to infection by direct contact with human cases or carriers, or (2) to infection from one or more of the following vectors: food, water, or milk.

With regard to the question as to whether the epidemic at Manteno State Hospital in 1939 might have been due to direct contact, it may be said that many of the early cases occurred in persons who had had no contact with one another, and that these persons had neither had universal contact with the first case in July nor with anyone concerned with the first case. This is especially clear with reference to the construction men who were employed on the various building projects about the grounds, and certainly had no contact with untidy patients (such as the first case), and who, nevertheless, contracted typhoid fever.

With regard to the question as to whether, in this particular outbreak, food might have served as a means of transmission of the organisms, it may be said that the men employed on construction projects did not eat food prepared at the institution, and that the same died was not served to everyone in the institution, and that even though the foods were prepared in the same central kitchen many of them were handled by different individuals.

With regard to the question as to whether milk and milk products might have played a role in the spread of typhoid fever at Manteno State Hospital in 1939, it may be said that the milk supply delivered to the institution was received from approved pasteurization plants, and that the raw milk produced on the institution farm was used only for cooking. Milk from the pasteurizing plant was delivered to the institution in sealed 10-gallon containers and was distributed in these original sealed containers to the individual wards. Therefore, if the epidemic was caused by milk contamination after delivery, one would expect the inmates of one particular ward or several individual wards served by one kitchen only, to have been stricken. If the point of contamination for the milk supply had been central, then one would expect the characteristics of the epidemic to be different, such as a much more acute onset, a lower mortality rate, etc. Again, in this case, the construction men working at the institution did not partake of the institution milk supply, and those who did consume milk either brought the product with them or purchased it at the institution commissary, which brought milk

from a different source and sold it in individual pint and quart containers, the seals of which were not broken. This latter supply was also from an approved pasteurization plant.

Water, however, was consumed by all persons on the institution grounds regardless of their classification as inmates, institutional employees, construction men, or visitors. It has been shown in the foregoing account that for many years this water supply, which was derived from 4 wells that secured their water from the creviced limestone, had been subject to contamination. It was further shown, by placing dyes and salt in various points of the sewer system, that this application was accompanied within a few hours by a very significant increase in the chloride content of the raw well-water. Further evidence of sanitary sewer leakage into the creviced limestone is shown by the fact that application of fluorescein dye to the sanitary sewage through certain toilets was accompanied by the appearance of this dye not only in the sanitary sewers but also in the storm sewers, both of which are laid in creviced limestone and were reported to have no direct physical connections.

As a result of these investigations, it appears that there was not only an outright leakage of sewage from the sanitary sewers into the creviced limestone, but also that this sewage seeped through the limestone and found its way into the wells which supplied the institution with water. Up until August 19, the water from these wells was pumped directly into the institution distribution system without treatment. In further support of the contention that sewage at the time of the investigation was directly contaminating the water supply through sewer leakage and seepage in the limestone, there is the investiagtion on the raw water from Well No. 4, made by an experienced bacteriologist, from which he was able to isolate *Eberthella typhosa.* Water from this well was used exclusively for several weeks preceding the outbreak. Crowning the foregoing evidence is the phage typing of cultures obtained from many fecal and urine specimens collected from the typhoid patients and carriers, which showed that many phage types were represented in the epidemic, suggesting that the causative organisms had been transmitted to the patients from many individual sources rather than by direct contact with a single patient or carrier. From this accumulation of evidence it would seem likely that the water supply was receiving direct contamination from the institution sewer system.

It has been commonly stated that one of the charactristics of a waterborne epidemic of any disease is the explosiveness of the onset of the epidemic. In the case of typhoid fever, however, it is well known that the incubationary period may extend from 2 or 3 days to as many as 40 days; it is also recognized that the onset of typhoid fever is generally insidious and is accompanied, at first, by the appearance of many general prodromal symptoms, such as fever, headache, backache, and chills, that are not peculiar to any one disease; it is clear, furthermore, that where typhoid fever involves individuals who are mentally ill, the onset of the individual case often cannot be definitely placed on any certain date.

It appears reasonable to assume that typhoid carriers were present in the institution previous to the onset, since, on the routine survey, many persons were found to be typhoid carriers and were subsequently proved, by repeated examinations, to be permanent carriers of typhoid-fever organisms.

In some of these instances a definite history was obtained of these individuals' having had typhoid fever several years prior to the epidemic.

Since the body wastes of these persons found to be carriers after the onset of the epidemic and the body wastes of the first typhoid patient reported were being discharged without special treatment into the sewer system of the institution, any possible contamination of the water supply from the sewer system might readily have involved the infection of the water with a variety of phage types.

The fact that most of the persons who developed typhoid fever during the epidemic under discussion had not been in the institution long suggests the possibility that, in some of the persons who had been there longer, active immunity to the disease may have been produced without clinical disease.

Although control measures were instituted during the latter part of August, the occurrence of new cases continued for a period of 2 months. This phenomenon was to be expected inasmuch as many of the inmates' cases were not discovered until the illness became obvious. Furthermore, many persons were afflicted with mild undiagnosed illnesses that may have been missed cases of typhoid fever. It is well known that missed cases and persons in the incubation stage of typhoid fever are capable of transmitting the disease. In spite of rigid precautions which were taken in public-health control of carriers and known cases to prevent the spread of the epidemic, it was impossible to insure against many close contacts such as could happen in any institution for the insane.

Another factor in the incidence of secondary cases was the lack of adequate continuous supervision over the public-health control of typhoid fever at the institution until September 20, when the Department of Public Health nurses were stationed at the institution for the purpose of supervising the carrying out of strict isolation technique at the hospital and in the typhoid-isolation wards.

Before the known typhoid cases were released from quarantine, 3 specimens of feces and urine were required to be taken for examination at weekly intervals, the first not sooner than 10 days following the disappearance of fever. Even though this release procedure was more rigid than that which was then ordinarily required by the rules and regulations of the Illinois Department of Public Health, subsequent examination of specimens submitted by persons who suffered with typhoid fever during the epidemic revealed that 17 who had been released as cured had actually become permanent typhoid carriers. It may, therefore, be concluded that the examination of 2 specimens of feces and urine for typhoid is not sufficient evidence upon which to base the criterion of cure.

From the experience gathered in this epidemic, it may be concluded that much more stringent control measures must be practiced in the case of an epidemic in an institution for the mentally ill than would be considered necessary elsewhere. Persons confined in this type of institution frequently cannot be held responsible for the practice of personal hygiene, even to the extent of exercising control over the rectum or bladder. Consequently, any disease which can be transmitted through body wastes is particularly difficult to control among such patients.

In order to ensure that the necessary procedures are carried out adequately, the experience in this epidemic would lead to the recommendation that only persons specially trained in the care of communicable diseases supervise the work.

In order to co-ordinate all control procedures, it was found effective in this epidemic to have all aspects of the public-health control work under the supervision of one experienced person charged with the necessary authority and having available reliable personnel for rapid and thorough execution of the control work.

The experience in this epidemic emphasizes also the value of giving full explanations to the people in the institution of the control procedures and of the reasons for instituting these procedures. If no explanation is forthcoming, the mass reaction on the part of institution personnel may border on panic.

## CHAPTER IX

# LEGAL ACTION RESULTING FROM THE EPIDEMIC

Following the epidemic, indictments were brought in Kankakee County, Illinois, against 3 persons concerned with the management and operation of Manteno State Hospital: the managing officer, the dietitian, and the director of the State Department of Public Welfare. The charges against the first two were eventually dismissed. The director of Public Welfare was brought to trial in the circuit court of Kankakee County, Illinois, Indictment No. 1847, People of the State of Illinois v. Archie Leonard Bowen. The jury was unable to reach a decision, and mutual agreement between the defendant and the State placed the decision in the hands of the judge. The decision rendered by the judge found the defendant guilty of omission of duty as charged, but this decision was subsequently reversed by the Illinois State Supreme Court. The opinions of the lower and the Supreme Courts are given in full at the end of this report.

An interesting controversy developed in the lower-court trial in connection with the introduction as evidence of the Department of Public Health results of analyses of water samples, together with the written opinions issued thereon. The prosecution contended that the analytical reports and written opinions of the State Department of Public Health should be given full weight as evidence. The defense, however, argued that these opinions on the analytical results gave no greater notice of danger than did the results themselves, contending that these opinions were merely those of persons giving them based on the facts disclosed by the laboratory results themselves, from which laboratory results or facts it argued that the defendant could as well formulate his own opinion, which would be as much entitled to weight and authority as the opinions given on these results by the Department of Public Health. In other words, the defense contended that the opinions written concerning the analytical results or facts added nothing legally that was not shown by the results themselves. It also contended that the State Department of Public Health in its analyses did not claim to find disease germs but merely the presence of *B. coli,* which, it pointed out, in themselves are harmless organisms. Further, that no differentiation was made in the reports between fecal and nonfecal types of coli. It was also pointed out by the defense attorneys that the defendant knew no disease germs had been found by the analyses, and, particularly, that no typhoid organisms had been isolated (previous to the epidemic). Furthermore, that he (the defendant) drank the water each month when visiting the institution and from a taste standpoint the supply was excellent, that the water was cold, and that he was justified in believing that it was safe. On this matter of the written opinions, analyses and field-inspection reports of the State Department of Public Health, the lower court ruled that reports or analyses be admitted in the record solely for the purpose of showing that the defendant was being informed that the water was unsafe and that an epidemic might occur at any time but not as substantive proof. The court with these restrictions admitted the reports and analyses as evidence, stating that they were true and correct insofar as the results of the analyses were shown and constituted legal evidence inasmuch as the officials charged with the responsibility of making these examinations and reports were all present for cross-examination and to testify as to their correctness.

Another interesting public-health point involved in the trial was the question regarding admission as evidence of the salt tests showing the seepage from the

sewer to the well and the isolation of the typhoid organisms from the water supply. The defense contended that inasmuch as these tests were made after the onset of the epidemic it would be necessary to prove that conditions in both the sewer lines and the water supply underground were the same at the time of the salt tests (August 29-30) as preceding the outbreak of the epidemic, which was dated August 19. The burden of this proof rested on the prosecution and while testimony was given to show that no changes had been made or were known to have occurred in either the sewer system or the water supply over this period, the prosecution admitted that it was humanly impossible to prove that all conditions underground were exactly the same on the days the tests were made as they were a few days previous when the outbreak started. The court ruled that neither the results of the salt tests nor the isolation of the typhoid-fever organisms could be admitted as evidence, inasmuch as these tests were made after the date of the onset of the epidemic and there was not sufficient evidence to show that underground conditions were the same.

The defense contended that the epidemic was caused by direct contact with a carrier, one Mary Ores, who died of the disease. Evidence was introduced to show that "Mary" had been moved repeatedly from one ward to another and that at such times she would have had direct contact with all early cases.

Civil action suits for damages, all eventually dismissed, were brought into the district court of the United States for the Northern District of Illinois, Eastern Division, against surety companies providing bonds for the managing officer of Manteno State Hospital, the director and the assistant director of the State Department of Public Welfare, and the director of the State Department of Public Health. When these cases were dismissed in the lower court, they were appealed to the United States Circuit Court of Appeals, Seventh Circuit, which upheld the motions for dismissal.

---

STATE OF ILLINOIS } SS.
COUNTY OF KANKAKEE }

IN THE CIRCUIT COURT OF KANKAKEE COUNTY

THE PEOPLE OF THE STATE OF ILLINOIS
VS.
ARCHIE LEONARD BOWEN

INDICTMENT FOR MALFEASANCE

NO. 1847

OPINION OF THE COURT

The defendant, Archie Leonard Bowen, was indicted by a special Grand Jury of Kankakee County. The indictment was returned and filed on November 21, 1939. This indictment consisted of three counts: the first charged the defendant with unlawfully, willfully and corruptly being guilty of a palpable omission of duty; the second charged him with being guilty of willful and corrupt malfeasance in office; and the third count charged him with maltreating a certain insane person.

The case was tried with a jury commencing February 13, 1940, and the jury after being out a considerable length of time, having failed to agree, was discharged by the Court. However, it not appearing to the Court from the evidence that the defendant was guilty of any affirmative acts of malfeasance or of maltreatment directed a verdict as to the second and third counts; so that there is remaining only for further consideration the charge made in the first count of the indictment.

The charge made in this first count was a violation of Section 208 of the Criminal Code. This Section provides in part as follows:

"Every person holding any public office (whether State, county or municipal) trust or employment, who shall be guilty of any palpable omission of duty, * * * or who shall be guilty of willful and corrupt oppression, malfeasance or partiality, where no special provision shall have been made for the punishment thereof, shall be fined not exceeding $10,000 and may be removed from his office, trust or employment."

This case was again set for trial before a jury on May 20, 1940, and after the selection of the jury to try the case, on May 21, 1940, The People and the defendant agreed to waive a jury and agreed to submit the case to the Court without a jury upon the evidence taken in the first trial. At the time it was agreed that briefs would be submitted and there was a request by the Court that both The People and the defendant point out any alleged errors in the record, so that the Court might have an opportunity of passing on the same and correcting any that should be corrected.

The parties have filed their briefs and pointed out various alleged errors. The Court will endeavor to pass upon them or such of them as he deems necessary to pass upon.

At the original trial of the case, after proof having been first made of the correctness of the information contained therein a large number of reports that the Department of Public Health sent to the defendant was admitted in evidence, which purported to show over a period from 1931 to the time of the epidemic in question, according to well known and accepted health standards, the water furnished the patients at Manteno State Hospital, Manteno, Illinois, was unfit for drinking purposes. On the back of these reports were warnings from the Department of Public Health to the effect that the water was unsafe for drinking purposes and advising that a dangerous water-borne epidemic might result at any time. The warnings contained on the backs of the reports, or in letters sent, was admitted in evidence by the Court with the restriction that they were being admitted solely for the purpose of showing that the defendant was being told that the water was unsafe and that an epidemic might occur at any time but not as substantive proof. The State's Attorney contends that the warnings should have been admitted as substantive proof. The Court is still of the opinion that he was right in his rulings in this respect. If the warnings were admissable as substantive evidence as opinon evidence the person making them would have to have been present with the right of cross examination. They simply amounted to a warining like a statement to one under a chimney, that the chimney is about to fall and, therefore, look out.

The State's Attorney also says that the Court should have admitted in evidence the making of a certain salt test and proof of the alleged isolation of a certain typhoid germ. The evidence showed that this alleged salt test and alleged isolation of a typhoid germ was long after the alleged offense was committed, and after the epidemic had reached its peak and there was no sufficient showing, in the opinion of the Court, that the conditions were the same as they were at the time of the alleged offense. The Court is, therefore, of the opinion that his ruling in this respect was correct.

The State's Attorney also says that the Court should not have admitted in evidence certain reports made by the Dearborn Chemical Company (two or four reports I have forgotten which) some years back stating that the water was safe to drink. These reports offered by the defendant were admitted with the same qualifications as those admited on behalf of the State. And the Court still feels that his view was correct, for the reasons heretofore expressed. They were expressions that the chimney was not about to fall.

The defendant first argues that the indictment is insufficient to charge a crime.

Judge South passed on a motion to quash the indictment and overruled the same. This Court concurs in the conclusion reached by Judge South.

Stripped of all surplusage, the first count of the indictment charges the defendant with being guilty of unlawful, willful and corrupt palpable omission of duty in failing to exercise reasonable care to furnish reasonably safe drinking water to the patients at the Manteno State Hospital, Manteno, Illinois. The evidence and the statutes clearly show that the defendant was charged with a duty of supervising and executively administering the Hospital. Being charged with that responsibility, can anyone say that he was not bound to exercise reasonable care to see to it that the patients had reasonably safe drinking water? To state the question is to answer it. All human life depends on safe drinking water.

The defense alleges that the venue is not properly laid in Kankakee County, because it is said that Mr. Bowen's office was in Springfield. It seems to me that the case of the People vs. Johnson, (66 App. 103) is conclusive on this Court as to that question, the Court on page 107 says:

> "But it is to be observed that the personal presence of the offender is not always an indispensable element in fixing the local jurisdiction of a criminal offense. A crime is, in legal contemplation, committed in the place where the doer's act takes effect, whether he is himself in such place or not; in this way one may even perpetrate an offense against a State or county upon whose soil he never set foot."

Moreover, the evidence in this case shows that the defendant personally supervised and inspected the Manteno State Hospital at its location, and on at least one occasion the condition of the water was a matter of discussion between himself, Dr. Hinton, and Dr. Hinton's secretary.

It is argued that the statute is unconstitutional because it imposes as a possible penalty a removal from office, and that this could only be done by the Governor and not as a judicial act. Even though the Governor may have power to remove an officer, I see no reason why that removal may not also follow as a part of the punishment for an offense, if an offense has been or is committed. The one is power vested in the Governor, the other is a penalty which may or may not be imposed and which is fixed by the Legislature.

It is argued by the defense that the Grand Jury was illegally constituted, because it is said the entire Grand Jury was hand-picked; and that the regular Grand Jury was in session. Judge South, however, passed on both of the objections and overruled them. Moreover, I find nothing in the record to show that the Grand Jury was hand-picked. As to the other question the Supreme Court in the case of The People v. Graydon, (333 Ill. 429) settled the law in Illinois that a special grand jury may return indictments even though the regular grand jury is in session.

It is also argued that the venire was not under the hand and seal of the Clerk. It seems to me that the only essential was that the grand jury was selected in accordance with the law and was present even though the venire had never been returned. In the case of The People v. Kramer (352 Ill. 304) the court held that even though a clerk omitted to attest the return before the grand jury it made no difference. The court says at page 306:

> "The grand jurors, so far as appears, were lawfully selected. Though the venire was void, its only service was to notify the grand jurors that they were required to appear at the time fixed. They were so notified and were present in court when, according to the law, they should have been. Being there, there was no reason to inquire when or how they were notified, and the court properly proceeded to empanel them for the purpose for which they had been selected."

The defense argues that the reports of the Department of Public Health should not have been admitted in evidence. The evidence showed that the reports were true and correct in so far as the results of the analyses were shown. I see no reason, therefore, why these reports were not competent. The officials, who were charged with the responsibility of making the examinations and having the reports made, were all present for cross-examination and testified to their correctness.

I come now to the question as to whether the proofs show beyond a reasonable doubt that the defendant is guilty as charged. The charge being, as I view it, that he willfully, intentionally and corruptly failed to furnish reasonably safe drinking water to the patients of the Manteno State Hospital, and was, therefore, guilty of a palpable omission of duty within the meaning of the law. (The People vs. Mays, 17 App. 361). In that case considering a statute of identical language here, the Appellate Court in speaking of what is meant by palpable omission of duty, says on page 366:

> "The finding that through intoxication he has at various times been guilty of neglecting his duties is tantamount to a finding of "palpable" omission of duty. We quite agree with counsel that the word "palpable," as here used in the statute, embraces the idea of an intentional and substantial failure to perform the duties imposed by law, partaking of the nature of a willful or gross neglect of the officer to attend to his duties. It would be a too restricted use of the word to give it the sense only of "easily perceived", "plain", or "obvious", as such a construction would make the officer liable to removal when he had omitted to perform any of the duties of the office, although his failure to perform the same may have occurred through accident, mistake or some personal inability, arising from illness or other cause, for which he might not be in any degree responsible, which certainly could not have been contemplated by the legislature as a cause for removing him. Through a mistake, that anyone is liable to make, he may present an erroneous report to the county board, showing his receipts and disbursements, and such report therefore be untrue as a matter of fact, and an examination of his books would plainly show the incorrectness of it, yet if it should also appear that the error was not intentional, but the result of a mistake of the officer it would certainly not be contended that he would thereby render himself liable to be removed by the board. But if it appeared to be a willful act, upon his part, done with the design to wrong the county, there could be no question that the board not only could, but should, remove him."

This case was afterwards affirmed by the Supreme Court in the case of John Henderson vs. The People of the State of Illinois. 117 Ill. 265.

The word "corrupt", in my opinion, means nothing more than willful and intentional. (Chicago City Ry. Co. v. Olis, 192 Ill. 514). On page 516, the court said:

> "The modification complained of consists in the insertion of the words 'intentionally, corruptly,' between the words 'has' and 'willfully,' so that, as given, the instruction reads that if 'any witness has intentionally, corruptly, willfully and knowingly sworn falsely,' etc. It is substantially conceded that 'intentionally' is synonymous with 'willfully,' and such reiteration ought not to make the instruction vicious. But as to the word 'corruptly' it is insisted that its use was equivalent to saying to the jury that although they should believe, from the evidence, that any witness had intentionally, willfully and knowingly sworn falsely to any material point in the case, yet they had no right to reject his testimony, when not corroborated, unless they should also believe, from the evidence, that such witness had been bribed or was to receive some sort of gain or reward. We are unable to agree with counsel in such respect. In such connection, 'corruptly' refers to the motive of the witness rather than to the means by which his testimony is obtained. So in OVERTOOM V. CHICAGO AND EASTERN ILLINOIS RAILROAD CO., 181 Ill. 323, it is said: 'It is the

corrupt motive, or the giving of false testimony knowing it to be false, that authorizes a jury to disregard the testimony of a witness.' Again, in 1 Bouvier's Law Dictionary it is said: 'An act may be corruptly done though the advantage derived from it be not offered by another.' And that learned author defines 'corruption' as being something against law, and illustrates its application by the case of a contract for usurious interest, wherein it was 'corruptly agreed,' etc. It would seem that a witness who should testify 'willfully and for the purpose of concealing the truth' would bring himself within the meaning of 'corruptly' testifying."

In charging a criminal intent as a matter of law, one is presumed to intend all natural and probable consequences which flow from his own deliberate act. He must not be charged alone by what he actually intendes, but how that act would be construed by a reasonable person. The intent may be inferred by the acts he did. An intentional disregard of a known duty necessary to the safety of the person or property of another, and an entire absence of care for the life, person, or property of others, such as exhibits a conscious indifference to consequences, make a case of constructive or legal willfullness. A sane person cannot utterly disregard consequences and then say that he intended to do no wrong. These principles are too well settled to require the citations of authorities. Just about all law violations justify themselves by a philosophy that they are right, the law is wrong, or that they intended no wrong.

I come now to a brief discussion as to what the evidence shows. A terrific epidemic broke out at the Manteno State Hospital as a result of which some 450 patients of the Manteno State Hospital became ill with typhoid and some 60 lost their lives. To me this is only important as showing the terrible effect of the thing, if an offense was otherwise committed.

The sewage plant was originaly built for a population of 2500, and was required to serve at times some 6000. No conclusion can be drawn from the evidence except that the sewage plant was grossly inadequate.

The entire area where the Hospital was located was underlaid with creviced limestone. As a result of this it is clear that if the sewage escaped from the pipes which carried it, it would find its way into the drinking water, unless all pipes were securely incased down for a sufficient depth to prevent seepage; and the evidence shows that this was not so. The evidence shows that commencing in 1931 and until the epidemic, tests were made from time to time by the Department of Public Health that owing to the large quantity of Coli-type bacteria that the water was not fit, according to the known standards, for drinking purposes, and that up to the time of the epidemic and from time to time the Department notified the defendant that a serious epidemic might occur at any time.

The State's Attorney has summarized the percentages of positive portions of drinking water during the years 1931 to 1939. They are as follows: (Taken from the original brief of the State's Attorney on page 25)

| | | | |
|---|---|---|---|
| 1931 | 17.3% | 1935 | 18.0% |
| 1932 | 21.8% | 1936 | 19.0% |
| 1933 | 2.7% | 1937 | 36.9% |
| 1934 | 23.6% | 1938 | 40.0% |
| | | 1939 | 55.3% |

It is a known fact and the evidence shows that typhoid originates in the human body and is carried about by excretion and that typhoid epidmics may be and at times are water-borne. Only in one year, according to known standards, did this water appear safe for drinking purposes.

The evidence in this case shows beyond all reasonable doubt that the defendant paid no attention whatever to the reports of the Department of Public Health, and on the contrary shows that on one occasion when the water situation was being

discussed while he was engaged in his duties at Manteno and the reports of the Department of Public Health were being presented to him, he said that the water would have to wait, that there were more important things to take care of. The epidemic broke out after repeated warnings; that it was water-borne, there is no doubt in my mind. The conditions to make it were all there. Visiting truck drivers drank the water and became ill with typhoid. Mr. Bowen himself testified before the grand jury that he was convinced as well as everybody else that the typhoid was due to the water, but that if he had the thing to do over again he would do just as he did; and that the only reason for not chlorinating the water, which the evidence shows would have avoided the epidemic and make the water reasonably safe, was the cost which the record shows is no more than ten to fifteen thousand dollars. Why Mr. Bowen refused to heed the warnings of the State Health Department, I cannot understand.

The defense adopts a theory that the epidemic was caused by a patient, Mary Ores. I do not believe that this Mary Ores had anything whatever to do with the epidemic. Her people visited her from time to time in close contact and nothing resulted. As to her (Mary Ores) Mr. Bowen when on the witness stand and when asked when he first learned of her and that she was the cause of the epidemic stated that it was after he had got into trouble and was looking for an out.

I must conclude that the evidence shows beyond all reasonable doubt that the defendant is guilty in a manner and form as charged in the first count of the indictment. The only extenuating circumstance that I can see is the tremendous burdens that either the law placed upon him or that Mr. Bowen took upon himself. Mr. Bowen is a man approximately seventy (70) years of age and with the exception of eight (8) years, has been in the State service since 1909; and to quote from the brief of the defendant on page 55, and which is shown by the evidence:

> "As director of Public Welfare he exercised an executive and administrative supervision over 25 public, charitable and penal institutions of the State of Illinois containing 56,000 patients, inmates or prisoners. These were scattered over the State of Illinois from Chicago to Anna and included institutions at Alton, Jacksonville, Kankakee, Dwight, Manteno, Menard, Peoria, and Joliet. He had supervision of the Board of Pardons and Paroles including supervision of parole prisoners. In the penal institutions of the State there were 13,000 prisoners. In addition to this there were 7,000 persons on parole. In the charitable institutions there were 56,000 patients and 2,000 on parole from the hospital. In southern Illinois there were held five clinics for tracoma. In the Institute for Juvenile Research in Chicago there was held the largest research clinic in the world. Five hundred hospital beds are constantly kept and 500 or 600 persons daily go through the dispensary. 350,000 people a year are treated in these public institutions. In addition to this service as Director of Public Welfare he was in charge of investigations of and allowance of old age assistance for which at the commencement of the service there were 138,000 applications and now are approximately 225,000. In this old age assistance service about $3,000,000 a month is paid out under his supervision. In addition to this service he is supervisor of the Federal Social Security Service for handicapped children involving about 20,000 crippled children and in addition to this about 4,000 or 5,000 dependent children placed in homes came under his supervisory jurisdiction. There are also 3,000 world war veterans that come within the jurisdiction of his service."

Through arrangements with the State's Attorney and Mr. Bowen and his counsel, I understand that indictments against Dr. Hinton and Miss Williams are to be dismissed on the decision of this case having been made, which understanding was reached upon Mr. Bowen having as far as within his power permanently removed these people from State service. Their indictments are somewhat similar

offenses of Mr. Bowen's. Dr. Hinton's position was local superintendent and Miss Williams was the dietitian.

The judgment of the court, therefore, is, and the clerk is ordered to enter the same: The defendant is found guilty in the manner and form as charged in the first count of the indictment.
June 27, 1940

---

## ILLINOIS STATE SUPREME COURT

DOCKET NO. 25947—AGENDA 5—OCTOBER, 1940.

**The People of the State of Illinois, Defendant in Error, v. Archie Leonard Bowen, Plaintiff in Error.**

MR. JUSTICE SHAW delivered the opinion of the court:

Archie Leonard Bowen, then director of the Department of Public Welfare of the State of Illinois, was indicted by a special grand jury in the circuit court of Kankakee county for the alleged violation of section 208 of the Criminal Code. (Ill. Rev. Stat. 1939, chap. 38, par. 449.) This act provides a penalty of a fine not exceeding $10,000 and removal from office for every person holding any public office, who shall be guilty of any palpable omission of duty, etc. It was charged that the plaintiff in error failed to take proper measures to render the drinking water at the Manteno State Hospital fit for drinking purposes and that, by reason thereof, an epidemic of typhoid fever occurred, resulting in many serious illnesses and deaths. The cause was first heard by a jury which failed to agree. The second trial was before the court without a jury and, by stipulation, was had upon a transcript of the same evidence which had been heard by the jury in the first trial. The court found the defendant guilty, imposed a fine of $1000 and removed him from his office as Director of the Department of Public Welfare, and that is the judgment reviewed by this writ of error.

The plaintiff in error makes a number of contentions, only one of which needs to be considered. He urges (1) that the evidence is insufficient to sustain the judgment, (2) that the statute under which he was indicted is unconstitutional, (3) that the venue was improperly laid in Kankakee county and (4) that the grand jury which indicted him was illegally selected. A consideration of the first point only disposes of the case.

It is to be noted at the very outset that Bowen is not a doctor, bacteriologist, nor any kind of a scientist, and that for such technical matters he was dependent upon the advice of the doctors in the Department of Public Health. He started in life as a newspaper man, having been born in 1869, and is now seventy-two years of age. From newspaper work he went into public charitable work and thereafter into supervising State charitable institutions in which capacity he served under five Governors, namely, Dunne, Deneen, Lowden, Emmerson and Horner. He served the State of Illinois from 1909 to 1921 and again from 1929 until 1940. Since 1909, he has served under every Governor except Governor Small, and his original commission was obtained under the Civil Service law.

At the time of the unfortunate events at Manteno State Hospital, which are hereinafter set forth, Bowen's duties were very extensive. The Department of Public Welfare, of which he was in charge, had more than ten thousand employees under his direction and supervision and these, in turn, had direct supervison over the following State Institutions: Ten Insane Hospitals, with 32,000 patients, five penal institutions with 14,000 inmates, two institutions for juvenile research, two schools for technical education of the blind and deaf, three institutions for veterans, an infirmary in Chicago, treating 350,000 patients per year, five clinics for control

of trachoma, treating 4000 to 5000 patients per year, a division of child welfare, the State Board of Pardons and Paroles, with supervision of all paroled prisoners during their period of rehabilitation, and the division of old age assistance, caring for approximately 138,000 pensioners. Without any effort at a detailed statement of the entire record, it is apparent from a mere recital of the foregoing facts, that the Manteno State Hospital could not have been expected to receive more than a small portion of the time of the director and the appropriations for the department.

The first case of typhoid fever at the Manteno State Hospital occurred in July, 1939, which was approximately the period of incubation for the typhoid *bacillus* after the admission of one Mary Ores, whose case will be noted later in this opinion. The next case was on or about August 15, 1939, and others followed swiftly thereafter until a total of 411 cases had developed. Nothing out of the ordinary, in the way of an epidemic, took place prior to August 15, 1939, at which time Bowen was taken rather desperately sick with a *streptococcus* infection, and, for several weeks and during the height of the epidemic, was so far disabled as to not know, except by hearsay, during part of the time, as to what the Department of Health was doing at the Manteno State Hospital.

It was the theory of the People that the epidemic was caused by pollution of the drinking water at the hospital, which came from four deep wells. The record indicates that the terrain at that place is underlaid with a creviced niagaran limestone, which is of such a character as to permit the sub-surface drainage of water to get through without being filtered. There were four wells, varying in depth from 227 feet to 1760 feet, and these were cased from the surface of the ground to varying depths. It is a further theory of the People that sewage escaped from the sewage disposal system of the hospital and, percolating through this creviced limestone, entered the various wells and thereby caused a pollution which brought about the epidemic of typhoid. It is contended that it was the defendant's duty to have a chlorinating plant installed, or by some other means to have prevented this alleged contamination. In this connection, it is to be noted that it was neither alleged nor proved that the defendant had any authority to expend the necessary eight or ten thousand dollars for a chlorination plant, nor that the Department of Health of the State of Illinois had ever recommended it.

It appears from the record that the State Department of Health has laboratories at Springfield, which regularly, at approximately monthly intervals, examines samples of drinking water from the various State institutions, and that this department has a series of stock-form recommendations numbered from 1 to 14 which are stamped on the back of the reports sent to the various institutions. These analyses of drinking water are made by chemists or bacteriologists and not by doctors nor by any one qualified to express any medical opinion. It seems that the routine procedure is for the examiner, who is sometimes a recently graduated chemical student, to note form number so and so to be stamped on the back of the report, which is done accordingly. Some of these forms say "the above analyses shows that the water is contaminated at the time samples were taken and was not entirely safe for drinking purposes." Other forms are "the above result shows that the water at the time of sampling was safe to drink. The continued safety of the supply is not assumed however. See previous reports and correspondence." The court admitted in evidence about 158 of these periodic reports, ranging in time from March, 1931 to October, 1938, and ranging in results from a statement of contamination in some of them to a statement in the latest of them that the water was safe for drinking purposes. There is no report of any examination within 7 or 8 months of the outbreak of this epidemic.

It is fully apparent from the record that no miscroscopic examination was ever made for the presence of typhoid *bacillus* and there is no evidence to indicate that typhoid *bacillus* was ever mentioned to the defendant until after the outbreak of this epidemic. The recommendations and opinions written or stamped on these

reports were clearly not admissible in evidence for a number of reasons: They did not show who made the examination, they did not show that the person who made the examination was qualified to make any recommendation and they constituted merely a voluntary comment by an unqualified person not present to testify in person nor subject to cross-examination. The most that can be said for any of these 158 exhibits, is that it showed the water to be either positive or negative as to *coli aerogenes.*

It appears from the record that *coli aerogenes* or *colon bacillus* may be friendly or inimical, and that the mere presence of the *colon bacillus* in water proves exactly nothing so far as typhoid fever is concerned. The tests seem to have been made by a method of broth fermentation, and determined nothing more than the presence or absence of some kind of *colon bacillus.* It further appears that this type of *bacillus* is present in the air one breathes, in milk, on fruits and practically everywhere.

It is further apparent that *colon bacillus* may be of the fecal or non-fecal type and that so far as typhoid is concerned it is only the fecal type from man alone (not from animals) that can spread the disease. The typhoid *bacillus* could not possibly have been identified by the laboratory means used in any of these reports and none of them is of any value to the People in an attempt to prove the guilt of the defendant. It should again be noted as above, that Bowen was not a doctor nor a bacteriologist, and that all of these reports passed through the hands of Dr. Andy Hall or Dr. Frank Jerka or Dr. Baxter in the Department of Health and that none of them either directly or indirectly ever mentioned typhoid to Bowen.

Even if these reports were of any probative value they would necessarily tend to disprove, rather than prove a case against the defendant. The water from these wells was consumed by all the inhabitants of Manteno for more than eight years prior to this epidemic. This test over a period of eight years, if looked upon as a laboratory experiment, would go a long way toward proving that the water actually was safe for human consumption, because there is no evidence of any abnormal condition as to typhoid occurring during that period of time. It is difficult to think of any better proof that could be offered that the water was free from typhoid *bacillus* and that the epidemic was not water-borne. The conclusion that it was not water-borne was also proved by an exceptionally well-qualified and experienced expert witness, who based his conclusion on the People's own exhibits. Still another reason for thinking that the epidemic was not water-borne is necessarily inferred from a total failure to prove that there existed any defect or leak in the sewage system.

The People offered the expert testimony of a young doctor employed by the Department of Public Health. This witness prepared a number of charts showing such essential points as the number of cases beginning on particular days during the epidemic, whether the afflicted person was an employee or patient, the age group of the various patients, their sex, whether or not they were food-handlers, the location of the patients within the numerous buildings, constituting the entire hospital, the number of cases in each separate building, with dates of incidence of the disease and other pertinent facts. This doctor was neither asked nor expressed any opinion as to whether the disease came from the water supply. The record discloses that at least ten qualified physicians in the employ of the Department of Public Health were at Manteno during the epidemic and not one of them was even asked by the People to express an opinion as to whether or not the epidemic had been caused by the drinking water. In fact, only two or three of them were called at all as witnesses, and one of these, Dr. Baxter, was later called by the defendant and testified that in his opinion the disease was not caused by the water. There is thus a total failure to prove, even by the opinion of experts, that the disease was caused by the drinking water as charged in the indictment.

At this point it is desirable to consider the case of Mary Ores, who has heretofore been mentioned in this opinion. This patient was admitted to the hospital June 12, 1939, which, according to the medical evidence, was about the normal period of incubation for typhoid *bacillus* before the first case of that disease occurred in the institution. She was so insane as to require feeding by tube through her nose, and refused to remain in bed, getting up continuously and roaming about the ward in which she was a patient. Physically, she was gross and filthy. She weighed approximately two hundred pounds, ran a constant temperature of from 99 to 103 degrees, suffered from a large carbuncle on her neck which required surgical treatment, and had an uncontrollable diarrhea, which she either did not or could not restrain. As a result, her person, clothes and her bed were constantly defiled with bodily excretions. At that time no one either had or could have diagnosed her case as typhoid, and she was, therefore, constantly and by the most virulent methods, exposing others in the ward, her nurses, attendants and those who handled her food and laundry. She was taken from her ward to a surgical ward for treatment and from the surgical to the non-surgical part of the hospital for a time, and later on returned to a different ward. She was moved several times and there is in evidence a large plat showing the exact places in the institution where she was from time to time. Her symptoms did not become such as to permit a diagnosis of typhoid to be made until two or three weeks after her admission and she died of that disease on August 30, 1939. Without detailing the testimony, it is sufficient to state that the first twenty-six cases of typhoid were medically directly traceable to this woman and that it is also true, from a medical standpoint, that all of the cases might be accounted for by either direct or indirect exposure to her and to those whom she infected.

The defendant offered the expert testimony of Dr. L. Loyd Arnold, who testified without compensation and whose testimony is in no manner impaired or impeached. In addition to the usual medical degrees, this witness had studied four years in Europe at the University of London, University of Oxford, at the Institute of Tropical Medicine in Hamburg, Germany, at the University of Goettingen, at the University of Munich and the University of Quebingen. His experience included service as biochemist at the Barnes Hospital in St. Louis, as pathologist at Nashville City Hospital and other such employments. At the time of his testimony, he was professor of Bacteriology and Public Health at the College of Medicine at the University of Illinois, Professor of Bacteriology in the College of Dentistry at the University of Illinois, and also in the College of Pharmacy of that institution. He had previously served as professor of Pathology, Bacteriology and Public Health for five years at Loyola University, School of Medicine, and as director of laboratories for seven large Chicago hospitals. For eleven years he served as bacteriologist in the Illinois Department of Public Health, in charge of its Chicago laboratory and was also, at the time of his testimony, a member of the Chicago Board of Health. During all of his experience, he had specialized in public health matters and epidemics. His experience with the latter included several studies in the field in the examination of actual epidemics which had occured in various places. This witness considered, analyzed and explained the various charts above referred to, which had been made by Dr. Eberhard and as to which Dr. Eberhard had expressed no opinion. It is the opinion of this witness that Mary Ores was suffering from a latent and not yet developed typhoid when she entered and while she was in the hospital, and that the epidemic was traceable to her. His reasons for this opinion are not only reasonable, but clear and convincing. He was quite positive that this was not a water-borne epidemic and we think the record proves this to be the fact.

It would unnecessarily prolong this opinion to make any further or more detailed analysis of the testimony of the great number of witnesses who were called. From what we have already said it is fully apparent that the People failed to prove the

defendant guilty and that no guilt could even be assumed, unless at the same time many facts not proved by the record were also assumed. It was not proved, and we cannot assume that any typhoid *bacillus* was ever found in the drinking water. It was not proved and we cannot assume that there was ever any leak or defect in the system of plumbing and sewage disposal, or that any such contamination entered either of the wells. In the face of the testimony of Dr. Arnold, it would be extremely presumptuous for any layman to assume that the infection came from any other place than the body of Mary Ores. On the other hand, we think the evidence clearly and satisfactorily establishes that the infection did come from that person and that the record, fully considered and properly construed, shows nothing at all to indicate any guilt on the part of this defendant.

In view of our opinion of this matter, it is unnecessary to consider any other errors assigned and it is not necessary to remand the cause for any further proceedings.

The judgment is reversed.

*Judgment Reversed.*